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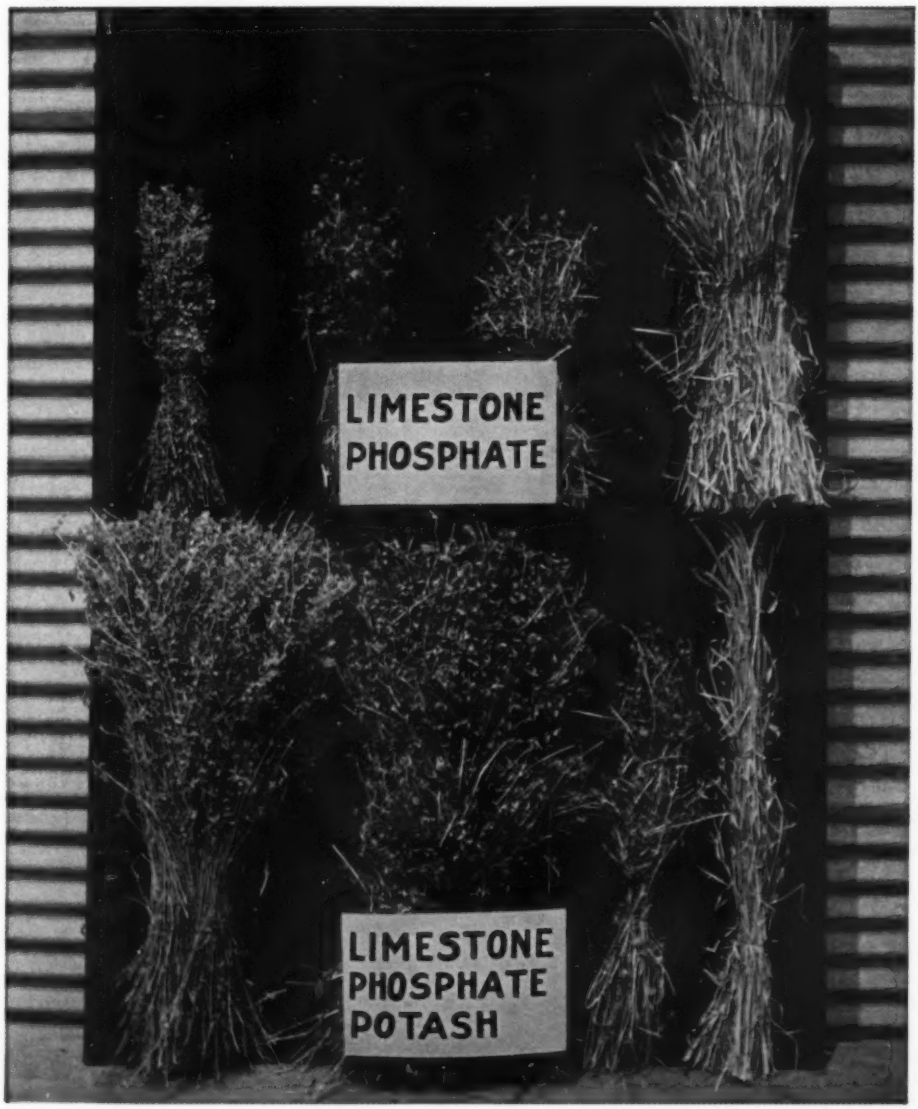

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Better Crops with PLANT FOOD

The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

Editorial Office: 1102 16th Street, N. W., Washington 6, D. C.

VOLUME XXXVIII NO. 4

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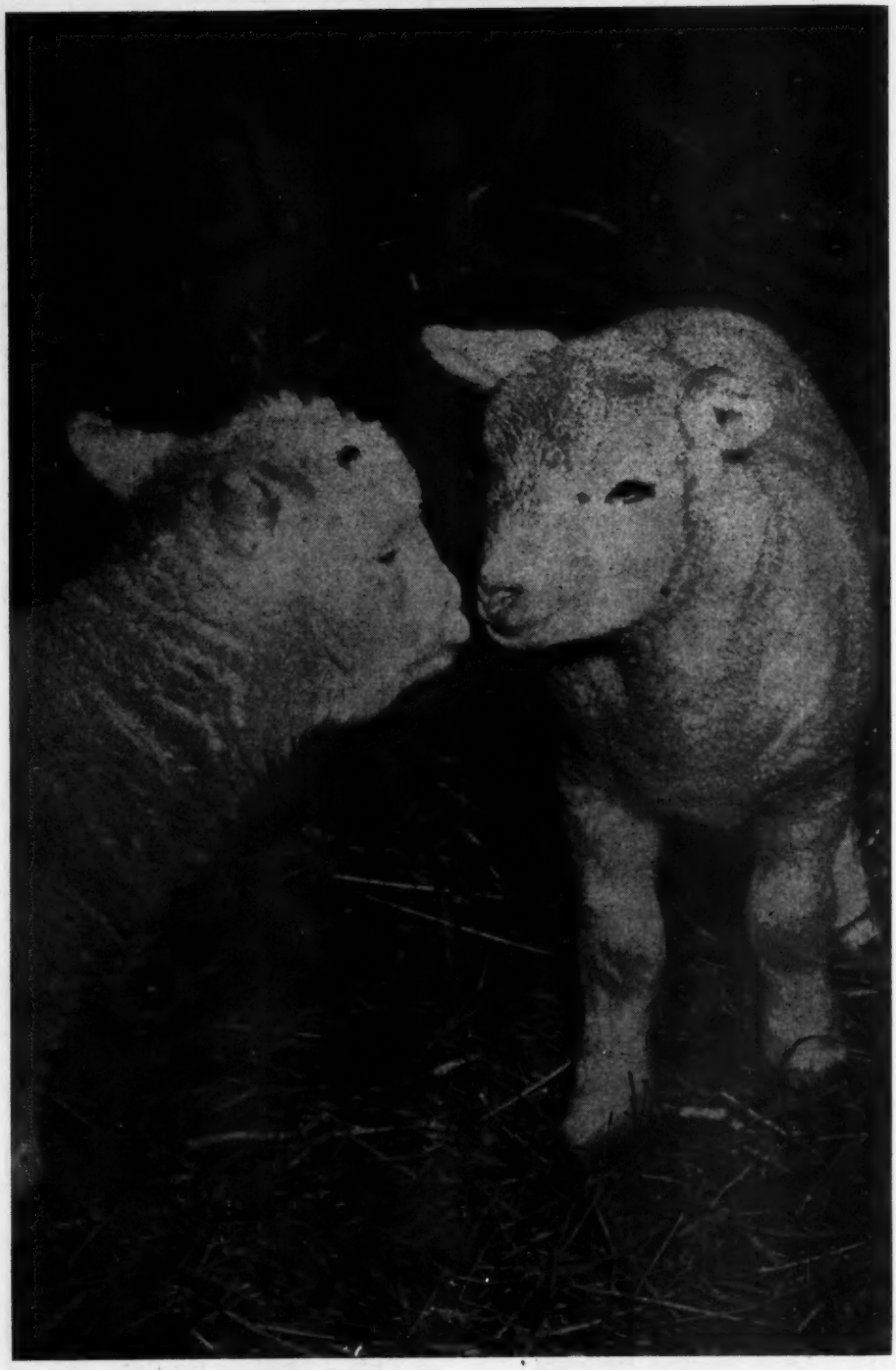

Cooking Up a Game!

Better Crops with PLANT FOOD

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VOL. XXXVIII WASHINGTON, D. C., APRIL 1954 No. 4

No fanfare, but . . .

High and Mighty

Jeff McDermid

THE teaching of vocational agriculture has quietly forged ahead to a place where its volume and value are serving as a mighty force to supplement the educational and demonstrational efforts of the regulation cooperative agricultural extension service. Because of this, it's time we said something about this high school arm of power that is reaching out to improve its practical services to the farm communities of the country. It's truly a "high and mighty" educational movement. The latest figures this scribe has seen indicate that there are more vocational agriculture instructors—about 10,700—than members of the entire professional extension force of county agents, or farm advisers, and the home demonstration agents and 4-H club agents.

Included in the estimated number of vocational agriculture teachers are those who handle regular day classes in high schools for students, as well as the ones who teach adult and young farmer classes, but not the veteran trainers. That these high school exponents of good farming are usually well-trained and educated gentlemen is without question. Most of them have college degrees in agriculture and science, plus to some extent a certain amount of normal school pedagogical training on the side. Thus they not only know modern farming fairly well or exceptionally so, but the majority of them are farm-raised and schooled more or less in skillful teaching methods.

Naturally, here and there, are seen fellows with less ability and punch than the average. They are not as effective as they might be in reaching the hearts and minds of teen-agers—the chaps who face their 18th year with a greater responsibility toward their country's service than most of the generations of youth experienced before.

Right here let's jump into a little pool of nostalgia a minute. Nostalgia and reviewing the past are not just the privilege and the weakness of aged gentry. They should be used—as they usually are—to mark guide lines and take time measurements in the pathway of progress.

YOU were probably one of the old-timers like me, who went to secondary schools where any suggestion of breaking the dead routine of the backbone studies with some sensible and workable pointers, to get a glimpse of future jobs, usually got slapped down hard by the board and the principal. More than that, as I recall those high school terms, most of the best students among the boys were fellows from farms. However, the percentage of the boys living on farms who managed to get parental consent to take time out winters to attend high schools was pretty blamed small.

Now maybe there was a reason for that, perhaps not a good one, but strong enough to sever connections in general between the bright kid from the country and what education the high school then offered. His folks simply felt that there was little for him to receive in city high schools except some extra flourishes in history and language and a fling at algebra and geometry. Of course, in those simple days of agriculture things had not grown so complex and scientific, and our contact with "foreigners" was not a necessity—except that we could pick up some of their language by neighborhood affiliations.

Give a chap a stub pencil and the smooth side of a board out near the corn crib and he could do all the ready reckoning and estimating he was obliged to do. And, thank you, the art of ordinary countrified arithmetic was the pride and joy of the seventh and eighth grades of the district school. Why lose a farm hand and take a long chance of causing a boy to wean himself from rural life by sending him to the high school town? He usually had to stay there all week, too, as even 10 miles was no cinch to travel twice a day.

But those were the days when each farmer went his way alone, had little time for new advanced "theories," and ignored the part that a sound education could play in successful agriculture. It was likewise before the advent of the industrial and commercial force which today links the businessman and his best interests directly to the welfare of the farmer.

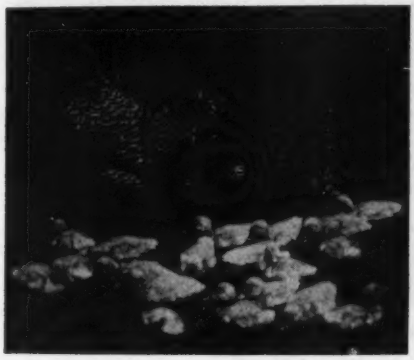
SINCE the vocational agriculture departments have developed to be a universal influence in better farming, better business, and better living, and since the spectacular growth of the Future Farmer chapters and the classes held for youths and adults not in school have expanded, the case is different. It means that businessmen are definitely in gear with the daily doings and the hopes and plans of the vo-ag classes.

Businessmen are deeply interested in giving encouragement to programs in the schools that are intended to develop stronger and well-trained rural leaders. They want to promote such new enterprises and methods as seem to be adaptable, and that multiply the power of the individual farmer to meet his obligations. They stand behind these modern things because it is the best way to maintain live and alert country towns and sustain them as trading and cultural centers.

It may be a blend of public spirit and self-interest. Whatever it is, it works. We have seen many businessmen, implement dealers, repair houses, service agencies, and manufacturers mix right in with the high school vo-ag groups in giving instructions and demonstrations, sponsoring fairs and con-

tests, and acting positively sometimes as members of local boards of education.

Above all, these business leaders like the whole spirit and concept behind the FFA and the technique and aims of vo-ag teaching. They usually realize that we have a responsibility to produce good American citizens first—men of broad good will who cherish the finer traditions of our country in more than a hollow gesture.



Take the ideal set forth in the FFA Creed, matching that of the foundation secured in 4-H club work:

"I believe in the future of farming with a faith not born of words, but deeds . . . achievements won by the present and past generations of farmers; in the promise of better days through better ways, even as the better things we now enjoy have come up to us from the struggles of former years."

It is no idle boast to believe that in many ways, every day these vo-ag high school departments are rendering a constructive service through a vital extension program. It bears no such official title or label. It's in-school teaching mostly, as contrasted with after-school and adult education systems kept in motion by the state agricultural colleges and experiment stations with the aid of increasingly large federal funds.

Leaving out for a moment the problems involved with non-school classwork that seem to be growing, let's give full credit to the high schools for reaching thousands of youths just on the threshold of active farming. The vo-ag teachers are not dealing with juveniles any longer and the tactics and technique that seem to get by fairly well with the age groups dominating 4-H work do not usually achieve equally good results when applied to regular students in day-long periods of instruction.

Incident and example profusely evident in the wake of sound high school vo-ag courses illustrate the firm effects that the work has had and is still having on soil conservation, animal husbandry, farm engineering, and rural leadership. It takes hold of the boy as he begins to have a real growing sense of responsibility, when he sees manhood right around the corner with all its duties and opportunities to be true to his family, his future, and his community.

Moreover, it actually makes the farms where these boys work into practical demonstration areas. Parents are happy to have their sons take this vital interest in agriculture, and willingly give to them and their teachers a large share of the deserved credit for advancements made and losses reduced.

NO closer relationship probably exists in agricultural extension work in general than between the good vo-ag teacher and his student and the student's family. Late messages from headquarters seem to indicate that a big test of a more helpful system of extension for individuals straight "down the road" is going to be made. One Illinois county agent reported that he undertook to visit with every farmer in several townships this past winter, going right from place to place without skipping. From a casual reading of his impressions, one gets the firm idea that this extension man met a great many farmers he had never reached before.

Over in Michigan in a few areas they are installing township county agents. This is an echo of the suggestive message again put out at headquarters. If the township system works

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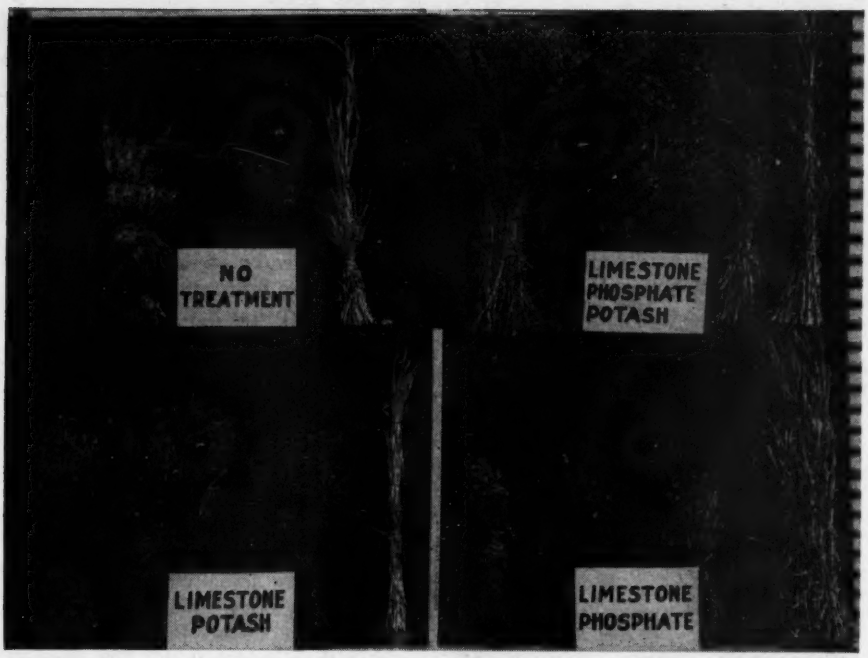

Fig. 1. Amounts and proportions of alfalfa, red clover, alsike, and timothy varied according to soil treatments. Mostly weeds with some timothy on untreated soils. Newton Soil Experiment Field, June 1953. See Table III and Fig. 3.

So You Want to Grow Alfalfa?

By P. E. Johnson

Department of Agronomy, University of Illinois, Newton, Illinois

THE drouth year of 1953 sold many more farmers on the value of alfalfa in hay and pasture mixtures. The ability of alfalfa to withstand drouth conditions has made livestock men and grain farmers alike more determined to grow it successfully on their own farms.

Alfalfa is naturally a deep-rooted crop, and when given a fair chance, we find its taproots extending deep into the subsoil. This enables it to utilize water far beneath the surface which cannot be reached by shallow-rooted clovers. Scattered alfalfa plants, which remained green and supplied forage in spite of drouth and the blistering hot sun, were very conspicuous in many virtually barren and brown pasture fields. Alfalfa, when once established on fertile soils, can take hot, dry weather. Also alfalfa seedlings usually survive a drouthy first season better than red clover, alsike, or ladino clover.

There have been many alfalfa fail-

ures in southern Illinois in the past; however, lone farmers here and there have been growing successfully this "Queen of Legumes."

Past Failures

Past failures have been blamed on the moon, wet feet, hard winters, and other causes too numerous to mention. Actually, lack of ample and balanced fertility is the real cause for most failures on the clay pan soils of southern Illinois.

These soils have a tight clay subsoil which does not allow rapid penetration of water. Such soils are also originally acid, low in phosphorus, and depleted in potassium, unless these conditions are corrected through plant food and limestone applications.

For the past 30 years alfalfa has been seeded and grown successfully in hay and pasture mixtures on properly treated plots at several long-time soil experiment fields conducted by the University of Illinois. The results have been excellent on those plots receiving combinations of limestone, phosphates, and potash.

Seeding Failures

Many farmers fail with alfalfa and clover stands because they do not meet the exacting fertility requirements necessary, especially in unfavorable seasons, judging from the long-time results and observations on our experimental fields. In 1953 some farmers complained of clover seeding failures during the dry season, but in the same neighborhoods excellent stands could be found where growers had followed soil test results and applied ample plant foods to their soils. Even on limed land, a deficiency of either phosphorus or potassium may lead to seeding failures in dry seasons, winter heaving during prolonged periods of freezing and thawing, and result in a predominance of grasses in the final hay or pasture.

Balance Gives Legumes

The multiple-deficiency gray silt loams of southern Illinois must have limestone, phosphates, and potash to produce both high yields and good quality hay.

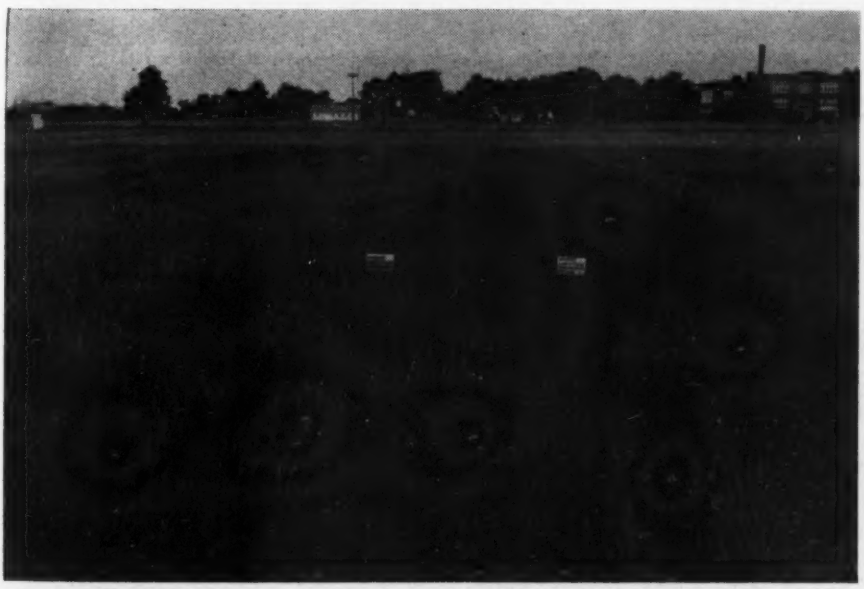

Fig. 2. Potash with limestone and phosphate (LPK), on right, produced more legumes. With only lime and phosphate (LP) on left, timothy predominated. Newton Soil Experiment Field, Newton, Ill., June 13, 1950.

The total hay yields on key plots at several Soil Experimental Fields are shown in Tables I and II. Note that single treatments are less effective than when the same amounts of limestone, phosphates, and potash are combined.

But total yields alone do not tell the whole story of benefits of the treatments on hay quality as well as yields. Marked differences in the proportion of legumes in the final hay harvested, due to various treatment combinations, are noted year after year.

The differences in hay quality are easily observed, but difficult to evaluate, except by tedious separation of species, plot by plot. Fig. 1 shows the results of such crop separation studies on four plots at the Newton Soil Experimental field. This is the actual hay which came from 1/1000 acre, or about 43.5 square feet, from each plot.

See data in Table III, from two experimental fields, for 1953 total yields and percentages of various species on certain plots.

But the actual differences in hay values due to both more hay and more legumes are well illustrated graphically. See Fig. 3, as well as the photo, Fig. 1.

The mixed hay seedings on the clay pan experiment fields are made about March 1 on small grains, mostly wheat. A mixture of alfalfa, red clover, alsike, and timothy is seeded crosswise of all plots in the series. This mixture lets us see this battle of the species, and points the way to increase the survival of alfalfa on our farms.

Battle of the Species

The seesaw battle between legumes and grasses, as noted continually on experimental plots, leads to interesting questions from farmers. It is not uncommon for growers to comment that their grass-legume seeding has resulted in a predominance of grass, or vice versa. Why?

Alfalfa wins out in the battle of the species only on those soils which have received adequate soil treatments. This legume gives a high-protein hay for high-producing livestock, and makes a beneficial contribution to the physical conditions of both surface and subsurface soils.

A summary of general conclusions

TABLE I.—FOUR-YEAR AVERAGE AND 1953 MIXED HAY YIELDS ON KEY PLOTS AT FOUR LONG-TIME SOIL EXPERIMENT FIELDS CONDUCTED BY THE UNIVERSITY OF ILLINOIS, ON GRAY SILT LOAM SOILS. TREATMENTS STARTED ABOUT 1912.

Treatments*	Mixed hay yields, first cutting only, in tons per acre							
	NEWTON		OBLONG		TOLEDO		EWING	
	4-yr. Av.	1953	4-yr. Av.	1953	4-yr. Av.	1953	4-yr. Av.	1953
None	.22	0	.41	.29	.48	.09	0	0
RLPK	2.45	2.11	2.18	2.21	2.03	2.06	1.50	1.87
R-PK	.....	.....	.....	.....	1.35	.69	.....	.....
RL-K	1.10	1.14	1.68	1.33	1.26	.75	.82	1.41
RLP-	1.96	1.13	1.73	1.41	1.30	.71	1.00	1.50
RL--	1.29	1.31	1.06	1.09	1.19	.75	.82	1.59
R-P-	.....	.....	.....	.....	.88	.42	.....	.....
R--K	.20	0	.58	.55	.82	.09	0	0
R---	.17	0	.51	.36	.44	.09	.02	0

* *Key to Treatments:*
R—Crop residues returned, cornstalks, soybean haulm, wheat straw, and second growth hay.
L—Limestone, total of 10 to 12 tons since 1912, to keep pH about 6.3. Relimed about every 10 years.
P—Rock Phosphate, total of 4 tons during 1912-1934 period, and none since.
K—Potash equal to 50 lbs. K_2O per acre per year average.

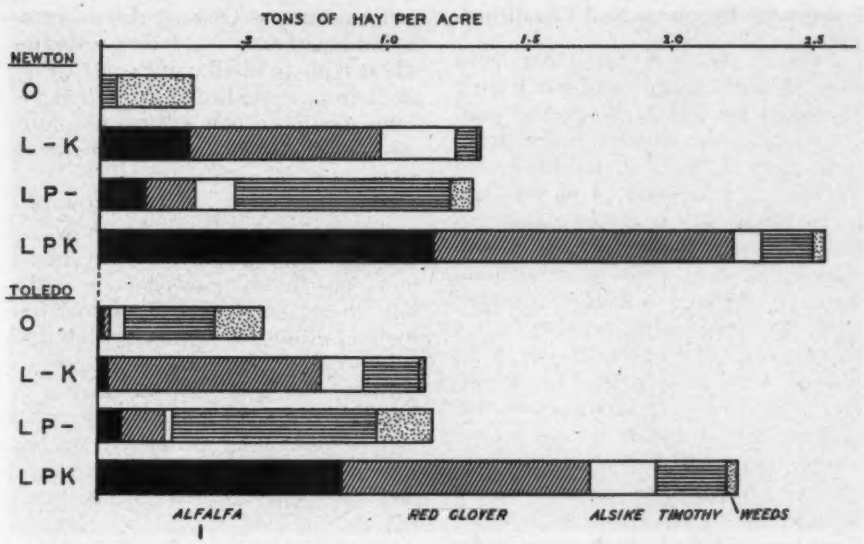

Fig. 3. Showing actual yields and proportions of different species resulting from mixed hay seeding on variously treated plots. Newton and Toledo Soil Experiment Fields, June 1953.

from these studies and observations might be about as follows:

1. Without lime, few legumes survive. But lime alone is not enough.
2. Single nutrients are less effective than combinations when more than one is limiting. Treatment must be adequate and balanced according to the need.
3. Timothy takes over when available potassium is so low that legumes cannot grow normally.
4. Alfalfa requires both high phosphorus and high potassium availability to compete with red clover.
5. Manure may not supply enough potash on these soils. Potash in addition to manure often gives a greater proportion of legumes.
6. When the right combination of limestone, phosphate, and potash is added, there is a normal distribution of legumes and timothy.

There are seasonal variations in the proportions of legumes dominating on the adequately treated plots. In dry summers, more alfalfa seems to survive the year of seeding, so the hay crop the next year will have a greater proportion of alfalfa. During a moist season the year of seeding, the red clover and alsike seem better able to compete with the alfalfa, and the next season more clovers will be found in the hay.

Manure Alone Inadequate

Extra potash applied on one half of plots which have received manure once every four years for 40 years gives a greater proportion of legumes as compared to timothy in most seasons. The timothy seems to predominate during the latter half of the growth period on manured sections without additional potash. Manure is applied equal in weight to dry matter removed in the previous rotation. The amount represents what a livestock man might be able to conserve and return to his soil. On low-potash soils where little potash is applied in the rotation, the resulting manure may contain less than the 10 lbs. K_2O equivalent as ordinarily credited to well-preserved manures from high-potash conditions.

Fig. 4. shows the effect of extra potash on manured plot at Oblong Soil Experiment Field.

Treatment Improves Soil Conditions

Unlimed plots on experiment fields often remain so soggy and wet during May that they cannot be plowed until a week or more after complete treatment plots (LPK), where deep-rooted legumes grow, should be plowed and planted to corn. No doubt part of this early drying effect on plots with legumes is from actual respiration of water. But a long-time indirect benefit from the deep-rooted legumes is apparent on the soil structure of both the plowed layer and unplowed subsurface soils. A more rapid penetration of water during and after rains is obvious on those plots with treatment combinations which grow highest yields of legume hays. Corn yields on such plots have been relatively high even in dry seasons, probably due to water conservation and increased nitrogen availability from the active organic matter.

Rotation Affects Structure

After 20 years of comparing two 3-year rotations at Oblong, that is, corn-soybeans-soybeans vs. corn-soybeans-wheat with an alfalfa and sweet clover catch crop, a marked benefit from the latter rotation is now evident on physical conditions and water penetration rates.

The differences in soil structure under these two rotations show up especially during and following heavy rains on freshly plowed soils. The soil from the corn-soybeans-soybeans rotation disintegrates more quickly and runs together, resulting in a compact surface. But where the second year of soybeans was replaced by wheat with a legume intercrop, the plowed furrow slice retains a more granular structure and runs together less during heavy rains.

The same variation in soil structure conditions can be noted in early summer following rains on freshly cultivated corn or soybeans. And water penetration differences have been demonstrated by soil profile studies.

(*Turn to page* 40)

Fig. 4. Extra potash, on right, in addition to manure, limestone, and phosphates, gave a greater proportion of legumes. More timothy on left half of plot, without potash. Oblong Soil Experiment Field, Oblong, Ill., June 12, 1950.

Fig. 1. A well-fertilized ladino cover crop in a Pennsylvania orchard. Increasing acreages of apple orchard are being planted to ladino. The fertilization under orchard conditions is identical with that of fertilizing ladino clover in pastures.

The Fertilization and Liming of Pennsylvania Fruit Soils

By R. B. Alderfer

Department of Agronomy, Pennsylvania State University, State College, Pennsylvania

FERTILIZATION is a very essential part of the broader problem of sound management of our fruit soils, that provides for the maximum control of the soil and water resources on suitable sites for a permanently productive fruit industry. This is important for several reasons, not quite so critical, as yet, in the production of most of our other important crops. Within any area the acreage of first-class orchard or vineyard sites is limited. In few lines of crop production are as many environmental factors liable to exert their individual and combined effects. The weather has a year-around influence on the orchard and vineyard. The same is true for living organisms ranging in size from the viruses to deer as causes of trouble to fruit growers.

Fruit trees and grapevines have a well-known tolerance for a wide variety of soil conditions. But they do best in deep, well-drained, yet moisture-retentive soils of high fertility. Unfortunately, fruit soils with these characteristics must be located on sufficiently steep slopes to provide for adequate air drainage during severe frost periods. Years of clean cultivation of the soil throughout the growing season in orchards and vineyards have permitted a greatly accelerated rate of physical, chemical, and biological deterioration to take place. Thus, overcultivation has led to a loss of organic matter, progres-

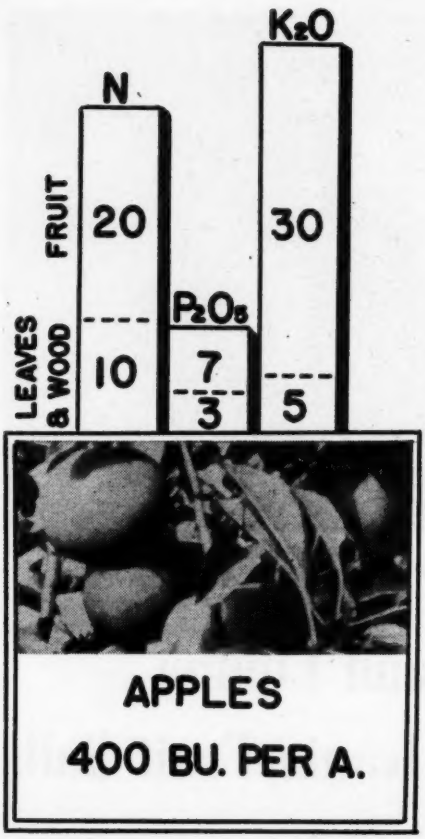

Fig. 2. Pounds of N, P_2O_5, and K_2O contained in the annual production of fruit, leaves, and wood of a good crop of apples.

sively poor tilth, soil erosion, and moisture problems of varying degrees of severity in a disturbingly high proportion of those sites presently used for fruit production. Acre yields have declined in proportion to severity of damage to any given location. This is or should be of concern to the fruit processing industry with large capital investments in those particular areas where productive fruit soil sites are the basis for their present and future existence.

What can be done to prevent further deterioration of present sites and to improve existing soil conditions? This can be accomplished by the use of the following basic soil and water conservation practices:

1. Contour planting and tillage, or at least cross slope tillage in existing orchards.
2. Necessary water control, ranging from the location and installation of level or graded terraces as interceptors of uncontrollable surface runoff, to crop residue management which aims to hold moisture from rain or irrigation where it belongs for effective use by the tree or vine.
3. Fullest use of sods, cover crops, and mulches for surface protection and the improvement of soil tilth.
4. Strict attention to the improvement and maintenance of a biologically active organic matter fraction in the soil.
5. A farsighted soil fertilization program designed to satisfy the annual nutrient requirements of the plant for maximum production, but also to make some investment for the future productivity of the site.

What have we learned about the fertilization of fruit trees and grapevines and the soils on which they are grown? An extensive amount of information has been accumulated as a result of experimental investigation, observation, and experience.

What have the experimental results shown? Of the so-called major or macro elements, nitrogen has been the one and often the only fertilizer element that seems to have had any direct effect on growth and yield, at least during the early years of the investigation. It is not too difficult to understand why this is so. Years of clean cultivation have accounted for a marked loss of organic matter, which contains practically all of the soil's reserve supply of nitrogen, by increased rate of decomposition and/or removal by erosion. Continuous stirring of the upper 2 to 4 inches of the surface soil keeps this layer almost devoid of roots because it dries out so quickly and because roots venturing into this layer are soon cut off and chopped up by cultivating implements.

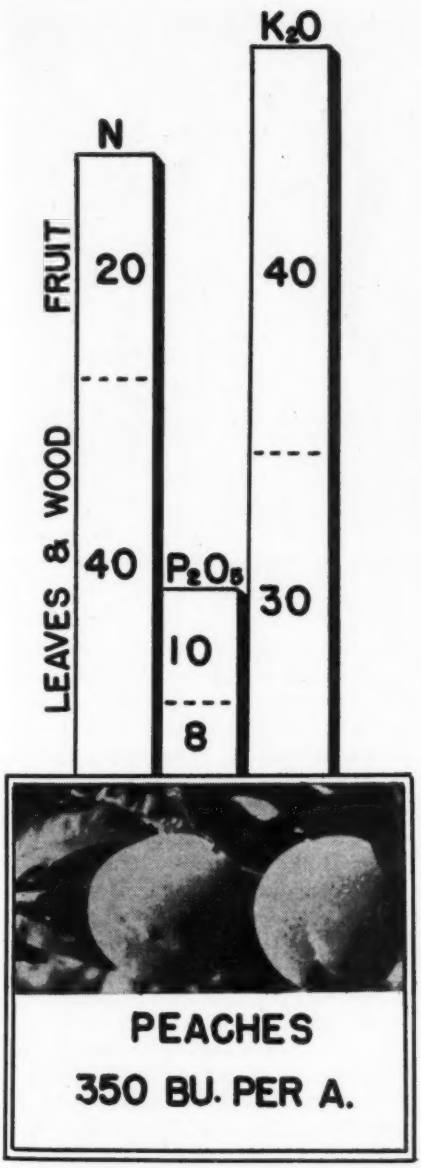

Fig. 3. Pounds of N, P_2O_5, and K_2O contained in the annual production of fruit, leaves, and wood of a good crop of peaches.

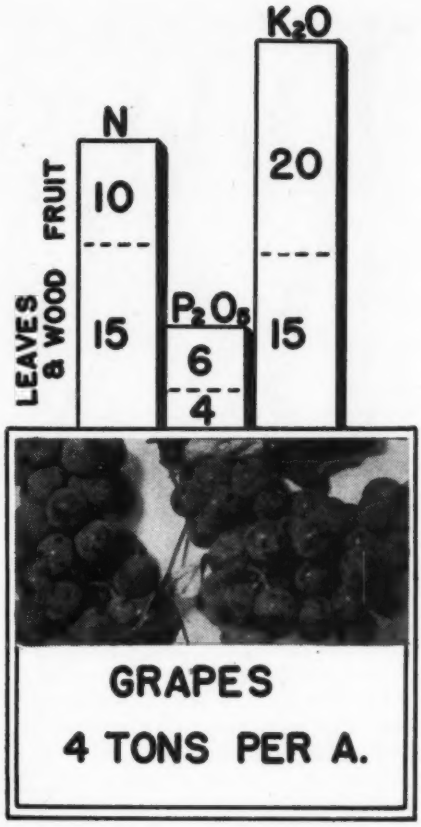

Fig. 4. Pounds of N, P_2O_5, and K_2O contained in the annual production of fruit, leaves, and wood of a good crop of grapes.

Where sods and annual cover crops are used, these plants usually have first chance at any available nitrogen or moisture in the immediate surface layer. Consequently, both cultivated and sod orchards have only a fraction of the total nitrogen-containing layer of the soil available to them. The thinner the surface soil, the smaller this fraction becomes and vice versa; thus, the high degree of correlation between depth of topsoil on well-drained sites and the size, growth, and yield of the tree or vine.

Since fruit trees and grapevines are perennial plants, their root systems have years of opportunity to grow into and, if conditions are desirable, remain to occupy rather completely that volume of surface and subsoil allotted to them. Thus, the annual needs of most fruit plants for all the other essential elements which they secure from the soil, except nitrogen, have been met by drawing upon the reserve supply of available

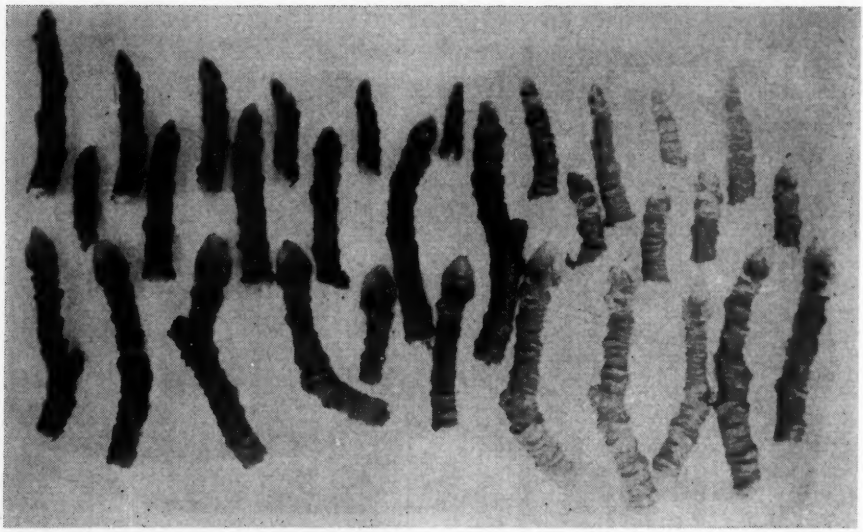

Fig. 5. Fruit spurs from trees receiving different treatments: Upper row—check—no fertilizer; second row from trees receiving nitrogen only; third row from trees receiving nitrogen, phosphoric acid, and potash.

nutrients throughout the soil by an effective root system. Deficiencies of the other elements do occur in certain areas and in certain seasons as a result of a low total reserve supply of a given nutrient, a high degree of fixation, pH, drought, or poor uptake due to ion antagonism or the ion exchange capacities of the roots themselves.

For years the only fertilizer element recommended for fruit trees and vines was nitrogen. If the addition of phosphorus, potassium, or calcium was recommended, it was for the benefit of the cover crop because marked improvement in the growth of the cover crop often resulted from the use of these elements with and sometimes without nitrogen. The results of the more recent fruit fertilization experiments, where generally larger amounts of the different nutrient elements have been used, are somewhat more variable with respect to the individual or combined effects of the elements studied.

Those areas in which fruit plants are now beginning to register a response to potassium, magnesium, and boron have reached the stage where the capacity of the soil to supply the required amounts of these elements for maximum production is becoming limited. The cumulative removal of the essential nutrients by cropping and erosion may be approaching and has actually reached the point in many orchards and vineyards where fertilization will have to supply a larger proportion of the future needs of the fruit plant for the major and in some cases the trace elements as well.

Most fruit soil management programs have allowed for a greater removal of all the essential elements by the crop except nitrogen than have been returned to the soil in crop residues or by fertilization. This may have been an expedient and often profitable practice. It was not, however, good fruit soil conservation because it could only lead to eventual deterioration in site productivity.

In Table I an attempt is made to evaluate our present fertilization recommendations for apples, peaches, and grapes in terms of the amounts of N, P_2O_5, and K_2O removed in fruit, leaves, and wood during a good crop year. This is not an effort to suggest what a satisfactory fertilization program

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Nutrient Balance Affects Corn Yield and Stalk Strength

By Flake L. Fisher

Division of Agronomy, Texas Agricultural Experiment Station, College Station, Texas

AN outstanding example of the need for proper balance between fertilizer nutrients in applied fertilizer was illustrated by a recent fertility corn study at Prairie View A & M College of Texas, Prairie View, Texas. The effect of improper nutrient balance on corn growth was evident by visual nutritional deficiency symptoms, and with some ratios severe plant lodging was present by approximately 100 days after planting.

The relative amounts of nutrients that are available for plant growth depend on the plant species, soil, and climatic conditions. The control of the relative amounts of grass and clover in a pasture mixture by nutrient balance is well known. This general principle is well illustrated by the type of vegetation found under native conditions.

Use of Factorial Test

The farmer is interested in a fertilizer program that affords a means of arriving at the most profitable amount and ratio of nitrogen, phosphorus, and potassium to use on a given crop for a given cost-price ratio between nutrients applied and marketable crops produced. One method now being used in Texas to help farmers solve this problem is the use of the factorial design in fertilizer experiments. A factorial test allows all levels of each nutrient to be applied with each level of the other nutrients used in the study. For example, a 120-pound rate of nitrogen was applied alone, with 40 pounds of phosphorus, with 40 pounds of potassium, and with 40 pounds of both phosphorus and potassium. The same was true for all other rates of each nutrient.

A fertility test of this type was conducted with corn on a sandy Gulf Coast Prairie soil at Prairie View A & M College from 1951 through 1953. A soil test indicated this area to be very low in all three of the primary fertilizer components: nitrogen, phosphorus, and potassium. A factorial design of four rates (0, 40, 80, and 120 pounds per acre) of nitrogen (N), and three rates (0, 40, and 80 pounds per acre) each of phosphorus (P_2O_5) and potassium (K_2O) was used. Each soil area received the same fertilizer treatment every year of this study. That is, if a plot received 40 pounds of nitrogen in 1951 it also received 40 pounds again in 1952 and 1953. Forty pounds of nitrogen and all of the phosphorus and potassium were applied simultaneously with planting. This fertilizer was placed in a band approximately four inches to one side and four inches below the seed. Those plots which received more than 40 pounds of nitrogen per acre were sidedressed about six weeks after planting. This nitrogen was placed about 12-14 inches to the side of the row and 5-6 inches below the surface level.

Deficiency Symptoms

A complete list of the different combinations and levels of nutrient ratios used in this test is shown in Table I along with the data for yield of grain and the percentage of broken or lodged plants. A plant was not considered lodged unless the stalk was broken be-

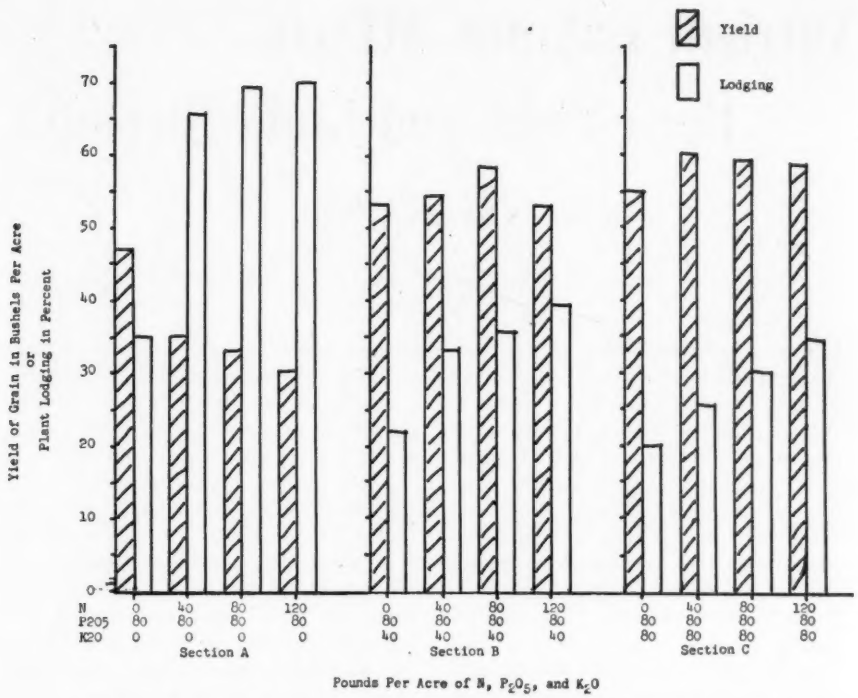

Fig. 1. The effect of nitrogen and potash on grain yield and lodging of corn.

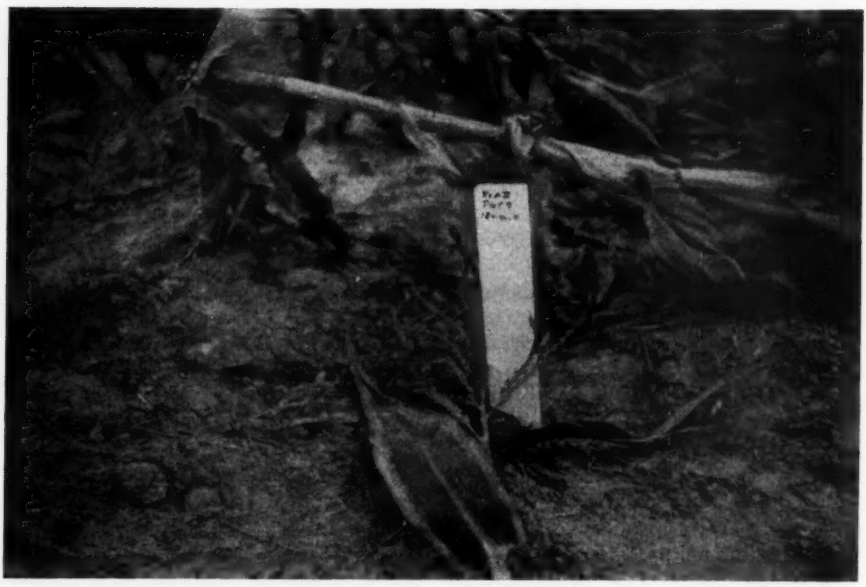

Fig. 2. The type of lodging encountered when the corn received no potash. Fertilized with 120 lbs. of nitrogen and 40 of phosphate, 34% of the corn lodged. The yield was only 40 bushels per acre.

TABLE I.—AVERAGE YIELD AND LODGING IN CORN FROM VARIOUS APPLICATIONS OF NITROGEN, PHOSPHORUS, AND POTASSIUM DURING 1951-53

Pounds per acre			Bu/Acre	% Lodged Plants
N	P_2O_5	K_2O		
0	0	0	29	54
0	0	40	40	34
0	0	80	50	28
0	40	0	34	42
0	40	40	49	23
0	40	80	56	24
0	80	0	47	35
0	80	40	53	22
0	80	80	55	20
40	0	0	28	64
40	0	40	44	39
49	0	80	46	39
40	40	0	34	63
40	40	40	55	32
40	40	80	58	22
40	80	0	35	66
40	80	40	54	33
40	80	80	60	27
80	0	0	28	69
80	0	40	37	39
80	0	80	44	41
80	40	0	30	77
80	40	40	53	32
80	40	80	56	32
80	80	0	33	69
80	80	40	58	36
80	80	80	59	30
120	0	0	29	53
120	0	40	47	49
120	0	80	41	36
120	40	0	32	67
120	40	40	55	37
120	40	80	57	33
120	80	0	31	70
120	80	40	53	39
120	80	80	58	34

low the ear. All grain was harvested by hand so that lodging did not cause a yield reduction due to ears on the ground being left in the field.

Visual nutritional deficiency symptoms were present within six weeks after planting. The deficiency symptoms became more evident as the plants aged. The two pictures (Figs. 2 and 3) show some of these conditions at the roasting ear stage or slightly later. Figure 2 shows the type of lodging encountered along with the visual potassium deficiency symptoms. Figure 3 shows the effect of potassium on ear development and size of the plant. The plant receiving a complete fertilizer had two well-developed ears, while on the plant without potassium, the ears were small and not filled completely to the tips. The stalk diameter of the plant where no potassium was applied was about ⅔ that of the plant with potassium applied.

The average yields of grain for the three years varied from a low of 28 bushels to a high of 60 bushels per acre. From the data in Table I it is seen that the unfertilized check area produced 29 bushels of corn with 54% of the plants being lodged. The three rates of nitrogen (40, 80, and 120 pounds per acre) when used alone did not give any increase in grain production above the check area. Nitrogen and phosphorus used together were not effective in increasing grain yield, while these combinations resulted in the greatest amount of stalk lodging, being 77% when 80-40-0 was used. The lowest rate of lodging, 20%, was associated with the application of 80 pounds per acre of both phosphoric acid and potash. This treatment produced 55 bushels of corn per acre. The application of 40 pounds of nitrogen at planting with the above rates of phosphoric acid and potash resulted in a 5-bushel increase in grain yield, or 60 bushels, while increasing lodging by 7%.

The tendency for nitrogen to increase lodging and for potash to counteract that effect is well illustrated in Figure 1. Obviously all combinations used in the test cannot be shown, so only those containing 80 pounds per acre of phosphoric acid and varying rates of nitrogen and potash are graphed. In Section A, with no potash used, nitrogen reduced grain yields and increased

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Tung Culture Finds a Place in South Mississippi

By H. B. Vanderford

Department of Agronomy, Mississippi State College, State College, Mississippi

THAT portion of the South long known for its beautiful forests and landscapes, and known to many as the "Piney Woods," is now producing an important crop that many other sections are unable to produce. This crop is tung oil. Because there was a definite need in this country for the valuable oil that tung nuts provide, this crop has taken its place in the land-use pattern in several states near the Gulf of Mexico.

The oil made from the kernels of tung nuts is used in the production of paints, varnishes, and other products. It satisfied a need for a quick-drying oil, and the demand naturally placed the tung crop in a favorable economic position. As a result, people who had faith in this crop and planted the seedlings on land suitable for tung trees have found the well-managed orchards quite profitable.

Tung was imported from China about 50 years ago as tung seed (3). These seeds were planted and disseminated by the U. S. Department of Agriculture and were tried by State Experiment Stations and some private cooperators. As a result of these early trials, tung trees seem well adapted to the Southeastern States where the growing season is long and warm, the soils are suitable, and the rainfall is plentiful.

The first successful commercial orchard was planted in Florida in 1924 (5), and some large-scale plantings followed in the late twenties. A few years later, extensive orchards were established in Alabama, Georgia, Louisiana, and Mississippi. After establishment and success of these orchards a definite Tung Belt developed, which now extends from northern Florida to eastern Texas. Since the tung tree is sensitive to frost, the width of this belt is limited to from 50-100 miles north of the Gulf of Mexico. See Fig. 1.

The climate over the entire belt is mild and humid with a long frost-free period each year. During the winter, or dormant season, the tung trees can withstand and often get quite a lot of cold weather. This type of climate is suitable for tung oil production and the growers have not had any serious disease or insect problems thus far.

Generally speaking, the soils found over the Tung Belt developed from leached, rather recent coastal plain deposits of sand, gravel, clay, and shale that tend to be low in native fertility. Those soils that developed from the coarse-textured materials, sands, and sandy clays are usually well-drained, permeable, and have depth sufficient for the production of deep-rooted plants. The soils that developed from the fine clays and shale tend to be shallow, impervious, and poorly drained. The tung tree is a deep-rooted plant and is rather particular about the soils on which it grows.

Sensitive to Soil Conditions

In soil development, which is one of Nature's great and noble processes, many things happen that help to determine the properties of the evolving soil, and much time is required. During the course of soil development, a mass of mineral materials is gradually

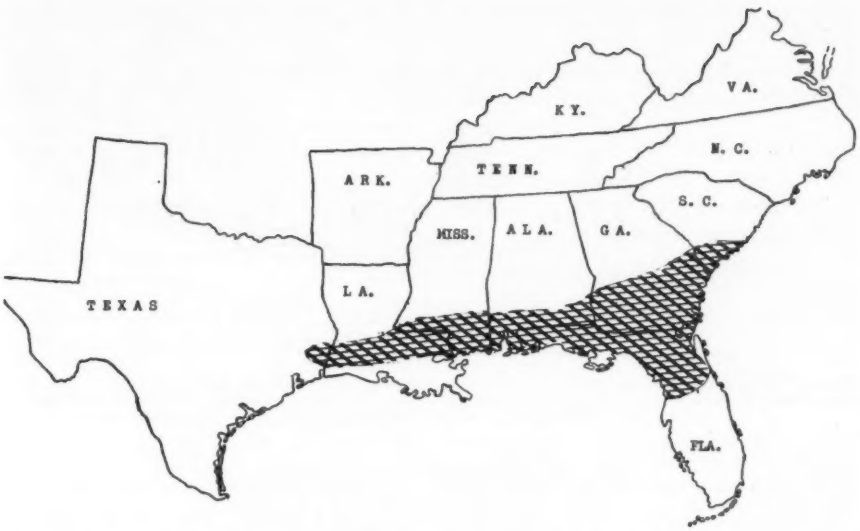

Fig. 1. The Tung Belt is located in the lower part of the Coastal Plain where the climate is mild and the rainfall is abundant.

changed from a heterogeneous mass into a definite body. This unit is called a soil profile and is made up of layers or horizons varying in thickness and other properties. Therefore, the general nature and the adaptability of a soil for the production of crops are governed by the characteristics of the layers (horizons) making up the profile and not by the surface alone. Many widely different soils may have surface layers that are similar. Thus, one must consider the properties of the various layers making up the profile when selecting land for different crops. Since the production of tung is a long-time enterprise and a long-term investment, the importance of the soil on which the trees are planted cannot be overemphasized. Many sad and costly mistakes were made in the early days of tung production by planting orchards on soils that were not suited for this type of plant. The following soil factors are important in the success of tung production:

Soil texture is that property of the soil that is governed by the size (coarseness or fineness) of its particles. These particles are classified into three groups which are sand, silt, and clay. Sand is the largest group of particles and clay is the smallest. The clay fraction is

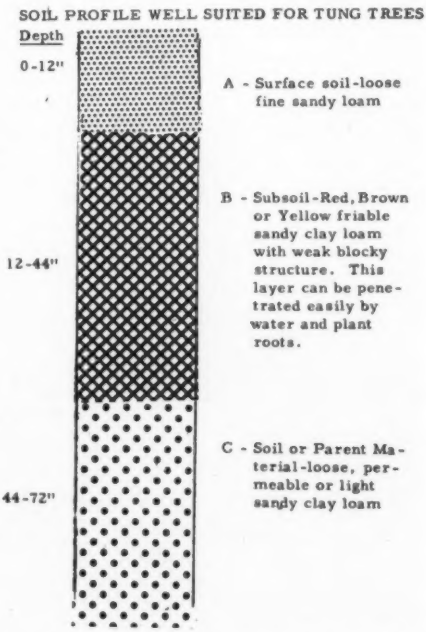
SOIL PROFILE WELL SUITED FOR TUNG TREES
Depth
0-12"
12-44"
44-72"
A - Surface soil-loose fine sandy loam
B - Subsoil-Red, Brown or Yellow friable sandy clay loam with weak blocky structure. This layer can be penetrated easily by water and plant roots.
C - Soil or Parent Material-loose, permeable or light sandy clay loam

Fig. 2. Tung trees are quite sensitive to soils on which they are grown. The soil should be deep, well-drained, permeable, and on an elevation high enough to provide air drainage.

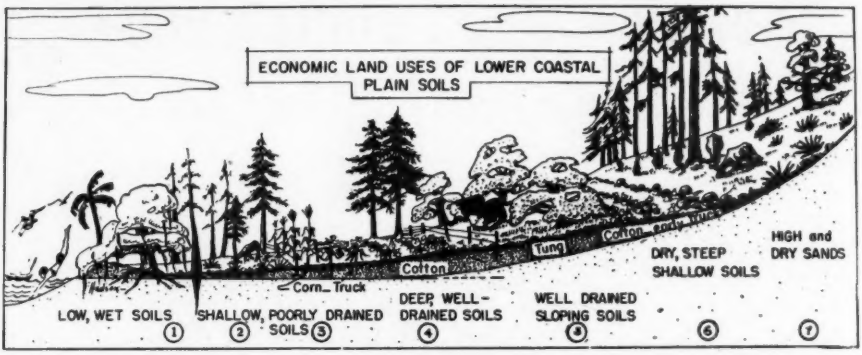

Fig. 3. Tung orchards have been successful on the deep, well-drained, sloping land, and this crop has a definite place in the land-use pattern. Other uses are more profitable on the shallow, poorly drained and shallow, tough soils. (Courtesy of Dr. O. T. Osgood)

very important, but like salt on an egg, too much clay in a soil is just as bad or worse than not enough. The most desirable textures for cultivated crops, including tung orchards, are mixtures of sand, silt, and clay which form textures like sandy loams, loams, silt loams, and clay loams. The texture of the subsoil is especially important since it governs other profile properties.

Soil depth may be thought of as the distance that roots, air, and water can penetrate freely into the soil. Some of the layers formed in the soil during soil development are cemented together and become quite hard. These layers are called hardpans. Other layers are extremely high in clay and are known as claypans. Still other soils may be shallow over a rock or water table, both of which would prevent the penetration and development of plant roots. Any of these layers, or a water table might render a soil unsuitable for the long-time investment of tung production. An effective soil depth of 36 inches or more is required for the best production of tung oil. Some soils with hardpans or other tight layers at less depth will produce tung fairly well provided such soils are on slopes sufficient to take care of surface water.

Fig. 4. A complete fertilizer is needed the first few years to produce a tree capable of producing high yields of fruit. These trees were planted on a soil suitable for deep-rooted plants.

Soil drainage is the movement of excess water off and through the soil. There are two kinds of drainage. Some water runs off the soils and is called external, and some percolates through the soil layers and this is called internal drainage. Drainage and soil aeration are associated, and one can get a general idea of the internal drainage of a soil by the color of the subsoil. This relationship is as follows:

Color of Subsoil	*Drainage Conditions*
Red	Well or Good
Brown	Moderately well
Yellow	Fair
Pale yellow and mottled	Somewhat poor
Grey	Poor

The internal drainage is influenced by

the texture, structure, permeability, etc., and is associated with soil depth. The external drainage is regulated by the slope of the land.

Well-drained soils that have sufficient clay in the profiles usually have a high water-holding capacity and can withstand droughts fairly well. The tung tree requires a lot of water, but is sensitive to excess moisture. The soils that are planted to tung orchards should, therefore, be moderately well to well-drained as well as have sufficient depth.

Slope or topography is defined as the configuration of earth's surface or just the lay of the land. In addition to removing the excess surface water, slopes have another value in tung orchards. This is the drainage of cold air from the high land into the low areas which decreases the frost hazard. Tung trees do well on slopes ranging from almost level to sloping or land that can be safely cultivated. Flat land is often associated with shallow hardpans or other layers and is not generally suited for tung trees.

The chemical properties involving plant nutrients (fertility), soil reaction, etc., can be taken care of by applications of fertilizers and lime. If the above physical properties are overlooked, however, the orchard may fail completely.

Soils that are well suited and safe for the production of tung should possess the following characteristics:

Good depth (36 inches or more)
Fairly good to good internal drainage
Medium texture (both surface and subsoil)
Slopes almost level to sloping
Good moisture relations.

Some specific soil series that have these characteristics include Ruston, Orangeburg, Red Bay, Greenville, Norfolk, Faceville, Tifton, Carnegie, Gainesville, and similar soils. These soils have little or no restrictions in the profiles to hinder root development. A soil profile well suited for tung and other deep-rooted plants is shown in Fig. 2. The place tung occupies in the land-use pattern can be seen in the chart in Fig. 3. Other soils with hardpans or impervious layers 24-30 inches deep have proved satisfactory for tung trees

Fig. 5. This 1,000-acre orchard failed completely. The seedlings were planted on Susquehanna soils. The few remaining poorly developed trees stand as evidence of the serious mistake of planting tung on the wrong land. (American Tung News Photo)

Fig. 6. Soils that are not suited for tung trees will produce good pasture. Tung trees failed on the land where the cattle are grazing fescue and white clover. In the background tung trees are growing well on land suitable for them. (American Tung News Photo)

when on slopes sufficient to remove the excess surface water. Some of these soils are Ora, Dulac, Franklinton, and Savannah.

Soils that are too wet, too shallow, or for other reasons not suited for tung production are Caddo, Susquehanna, Pheba, Leon, Bladen, Blanton, and similar ones. They have other profitable uses and should never be planted to tung.

As pointed out before, the parent materials from which the soils of the Tung Belt developed were low in plant nutrients. Consequently, the soils that are planted to tung are low in native

Fig. 7. Low, wet land will not produce tung orchards, but can be used for Dallis grass and lespedeza. (American Tung News Photo)

Fig. 8. A tung orchard is a beautiful scene when in bloom. These trees are about 16 years old. (Courtesy of W. W. Kilby)

fertility. This means that the tung grower must apply nitrogen, phosphorus, potash, lime, and minor elements as needed by the developing tung trees. As would be expected, young trees do not need the same kinds and amounts of fertilizer as older trees in full production.

After the land has been well prepared and terraces and contours constructed to prevent excess soil erosion and provide water disposal, the seedlings are planted on the contours at the rate of about 100 per acre. The object of the fertilizer applications for the first few years is to produce a good healthy tree. A standard mixed fertilizer, like 5-10-5, is recommended in the spring after the seedlings are planted at the rate of ½ to 1 pound per tree. As the tree becomes older, the fertilizer ratio is changed to fill the needs of the plant, and about 1 pound per year of age should be added. In other words, a 5-year-old tree would need 5 pounds of 12-8-8 fertilizer, or its equivalent. Later when the trees are mature and producing two or more tons of nuts per acre, the ratio should be changed again so that more potash will be applied.

Table I gives the approximate requirements of tung trees for plant nutrients in the various states.

The main product of the tung crop is oil, and naturally the potash requirement is high. Since the price of a ton of tung nuts is determined by the oil

Fig. 9. A fertilizer high in potash is necessary for tung nuts high in oil content. (Mississippi Experiment Station Photo)

Fig. 10. Cultivation is a part of the management of a tung orchard.

content, the good grower tries to produce high yields (2-3 tons/A) with a high oil content.

In order to do this, the fertilizer used must be high in potash. A grade like 10-5-10 is recommended for mature trees in heavy production. Orchards that produce 3 to 4 tons of high-oil nuts per acre make a terrific drain on the potash supply in the soil. Future research on tung fertility may show that higher rates of potash are needed for old orchards.

Cover-crop Production

Winter and summer cover crops are grown in most of the tung orchards. Whenever this practice is used, lime and fertilizer must be added to take care of the cover-crop needs. Such crops are usually heavy feeders on lime and phosphate, and basic slag is a good material for them. Good results can also be obtained from superphosphate and dolomitic limestone. The cover crops are usually turned into the soil, but in some cases they may be grazed and some beef or milk may be produced in the tung orchards. This provides another income from the same land and serves as insurance in case the tung crop is damaged by late frost.

Yields and Income per Acre

The price of tung oil, like other agricultural commodities, tends to fluctuate widely. In 1949, tung oil was added to the list of agricultural commodities which have price support. The actual yields in orchards vary greatly because of the many things involved, but the orchards that were planted on good tung soils and properly fertilized and cared for are producing 2 to 3 tons of nuts per acre. Such yields of high-oil nuts would give the grower a high income per acre. The base price is on nuts containing 17.5% oil. The price is raised 36 cents for each additional one-tenth per cent oil content. Tung growers have received from $60 to more than $100 per ton for tung nuts. The total production of the Tung Belt by states is shown in Table III. As can be seen from the data, Mississippi is producing more tung oil than any other state.

One of the interesting and significant points about the tung industry is that

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Some Reasons for Poor Crop Stands

By R. P. Moore

Agronomy Department, North Carolina State College, Raleigh, North Carolina

REASONS for poor crop stands may arise from the inherent conditions within the seed, or from the adverse changes brought into the seed, either before or after planting, by outside forces such as different levels of temperature and moisture. Germination of the seed and the type of seedling development are completely guided and rigidly limited by these forces. Any factor, regardless of how obvious, which weakens a seed to a level below that of a vigorous healthy structure may contribute to a poor crop stand. Good seeds of the best adapted varieties or hybrids unfortunately do not always overcome the hostile environment of a seedbed, but good seeds are normally superior to weakened seeds in performance over a wider range of planting conditions.

Varietal Differences

It has been stated that many of the powerful forces that influence crop stands have their beginning with the breeding of a variety or hybrid. It is known, for example, that the differences in inheritance or breeding of varieties or hybrids reflect definite changes in the degree and the certainty of stand establishment under a wide

Fig. 1. The cotton seedlings on the left are in difficulty resulting from the failure of root tips to elongate in the normal manner shown by the four seedlings on the right. Note that the roots on the eight abnormal seedlings are very small and that the structure above the root (hypocotyl) is enlarged. These abnormal seedlings, resulting from aging, temperature extremes, and other adverse germinating and growing conditions, may give rise to poor and spotted stands of weakened plants.

Fig. 2. Snap bean seedlings showing the effects of a stage of possible aging. Note that the seedling in the lower left has only a blunt enlargement in place of the extended root normally produced. It may be noted in the other seedlings that the root tips appear more nearly normal but are not elongating. This condition apparently causes the root tips to remain close to the seed while the structure (hypocotyl) between the root and seed cotyledons elongates into a semi-circle. The abnormal seedlings often account for poor stands.

range of less favorable planting conditions. The differences in seedling establishment arising from inheritance may be observed as tolerance or intolerance to low or high temperature, to dry or moist soils; or as susceptibility, resistance, or immunity to diseases and insects.

Growing Conditions Prior to Harvest

A second early cause for poor crop stands is that due to the natural preharvest weakening of seed vigor. Excessive high temperatures during ripening, for example, are believed to be one of the causes for reduced seedling vigor and low germination of soybeans harvested in many areas in 1936, 1939, and 1952. High humidity and frequent rains, after a seed reaches maturity, also have an adverse effect upon both seed vigor and life. High temperature and humidity, acting both independently and together, promote high rates of respiration and rapid degeneration, insect and disease activity, as well as the formation of breaks in seed coats and the fracturing or altering of other seed structures.

The heavy preharvest degeneration of life within cotton seeds in extreme eastern North Carolina in comparison to the better preservation of the higher quality crop in other parts of the State serves as a good example of weathering differences. Simpson of the Tennessee Agricultural Experiment Station, in seeking an explanation for field deterioration, found that when freshly opened cotton bolls were immediately exposed to a few days of humid rainy weather, there was a rapid loss of vigor and vitality, both before and during storage and later. Cotton seed which had been dried to a lower level of moisture before being subjected to such humid conditions was found to be more resistant to the detrimental influence of weathering. Weathering influences, however, continue to work ceaselessly.

Harvesting and Processing

A third important time in the life of a seed, as it relates to seedling establishment, is during harvesting and processing. During harvest, especially, many kinds of seed receive their greatest vigor-weakening and life-taking knocks, many of which are unsuspectingly brought about by improperly adjusted and operated combines and later rough handling. Excessive cylinder speed in harvesting is a most deadly enemy to crop stands. It leaves in its trail a high percentage of broken and chipped seed, and of greater significance to the seed user, it leaves a much higher percentage of invisibly, than visibly, damaged seed which has been roughly preconditioned to succumb readily to adverse planting conditions.

Studies have shown that the drier the seed at harvest and the faster the cylinder speed, the greater the external and especially the internal injury. Many seed growers have failed to realize this to the extent that they have used proper precautions to keep the damage at a practical minimum. It is true that processing equipment will remove most of the external damage and result in a good-looking lot of seed, but processing may even add to

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PICTORIAL

Chivalry !

Above: Night plowing.
Below: Day dreaming.

Above: A steady hand.

Below: Two on a raft.

Left: An April Sky.

Below: Contented Cows.

The Editors Talk

Our Cover Picture

Legumes can compete well with grasses in legume-grass mixtures when the potassium supply is adequate. Many experiments have demonstrated that legumes are at a disadvantage under low-potash conditions.

It frequently has been stressed that legumes have a high potash requirement. Grasses also like potash and use a lot of it. The fact that potash is more often stressed in connection with growing legumes than in growing grasses is due to the relative foraging abilities of the two groups of plants. Grasses have a better foraging ability for potash in the soil and this means that they can get along better than legumes on a low potash supply and may not respond so much to potash fertilizers. Moreover, when the two are grown together, this superior foraging ability results in the grasses getting the potash and the legumes starving. Extra potash, therefore, is frequently required for legume or legume-grass seedings in order to take care of the potash requirement of the weaker feeding legume.

The colored cover page of this issue illustrates what happened when a mixed hay seeding was planted side by side on low- and high-potash soil conditions. Here are two sections of an exhibit prepared by Professor P. E. Johnson, University of Illinois, following a species separation study on hay from several differently treated plots from their Newton Soil Experiment Field. The photograph shows the amount of alfalfa, red clover, alsike, and timothy hay which came from 1/1000 acre from each plot, after the species had been separated, dried, weighed, and mounted on plywood for an exhibit.

A mixed hay seeding lets us see this "battle of the species" which always exists in such mixtures. This gray silt loam prairie soil requires limestone, phosphates, and potash to grow good legumes. Without limestone, few legumes survive. With limestone and phosphates but without potash (LP-), the legumes are stunted, so timothy expands during the latter part of the growth period, as indicated in this photograph. With limestone and potash, but without phosphates (L-K), red clover grows relatively better than alfalfa under such low-phosphate conditions. In other words, alfalfa has a high requirement for both phosphates and potash. With adequate fertility (LPK), there is a distribution of legumes and timothy about as to be expected during a dry season. For a complete story of these experiments, turn to the article "So You Want to Grow Alfalfa?" by Professor Johnson in this issue.

The practical aspects of the above observations stress the need of balanced fertility, with plenty of potash as well as limestone and phosphates, if legume stands are to be maintained in mixed hays or pastures. Total yields alone may not tell the true value per acre of hay or forage. In fact, for the home feeder the quality of the forage undoubtedly outweighs the quantity, making more important than ever the legume content of the hay and pasture to maintain a high protein feeding value. It is generally conceded that a high-protein forage represents the cheapest feed for livestock.

Brains vs. Brawn

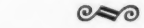
In the push ahead for new science in agriculture, how many of us stop to reflect on progress already made—progress which has almost revolutionized our agriculture within the last hundred years? We are amazed at some of the great machines constantly being developed to increase efficiency, or with this or that new discovery, but do we really realize what science has meant to our oldest and most important industry? A good mental picture of this progress was drawn for attendants at the 60th convention of the Farm Equipment Institute in Chicago last fall by Dr. Earl L. Butz, Head of the Department of Agricultural Economics, Purdue University.

"Let us imagine for a moment," Dr. Butz said, "that a good Egyptian farmer in the day of Moses could have been brought back to life in the days of the Caesars, some 12 centuries later, and placed on a good farm in Italy, then the most advanced nation of the world. He could have farmed with practically no additional instruction, for the art of agriculture had changed little if any in the intervening 12 centuries. Let us now imagine that same farmer brought back to life on a good English farm in the days of Shakespeare, some four centuries ago. He still would have been a pretty good farmer with no additional instruction. Now let's bring that same ancient Egyptian farmer to the Eastern shores of America 150 years ago and put him on Thomas Jefferson's farm, one of the advanced farms of that day. He still would not have found the art of farming very different from that which he had practiced in Egypt nearly 3,000 years earlier. He still would have used the same motive power, the same crude implements, and a large amount of hand labor. He would have known very little about fertilization, improved varieties, high-producing breeds of livestock, and the hundred mechanical and electrical gadgets on our modern farms.

"Now imagine for a moment that same farmer on a modern American farm. He would be completely bewildered. He would not even recognize the working end of the tractor parked in the farm yard. He would probably raise the cry of 'witchcraft' at all the wonderful things performed by mechanical and electrical power. It would require hard years of instruction and apprenticeship for him before he could even begin to operate the modern American farm."

Looking ahead, Dr. Butz sees a future filled with interesting challenges. Science will dominate the next century. Brains will continue to replace brawn in American agriculture. Man will direct power rather than supply it. Production per man will continue to increase. This means still larger agricultural units with more capital. It means increased mechanization and higher standards of living for those who produce our food and fiber. Farming will be even more "big business" than it is now. It will be still less a "way of life" than now.

The possibilities surrounding the use of atomic power alone furnish some clue of what another century might mean to American agriculture. A look at the past and the way American farmers have taken and used science gives confidence of a leadership in the future in which there is security.



"The surest way for any group in this country to commit economic suicide is to forget the ultimate consumer." . . . *Ezra Taft Benson.*

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb. Aug.-July	Tobacco Cents per lb.	Potatoes Cents per bu. July-June	Sweet Potatoes Cents per bu. July-June	Corn Cents per bu. Oct.-Sept.	Wheat Cents per bu. July-June	Hay [1] Dollars per ton July-June	Cottonseed Dollars per ton July-June	Truck Crops ....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
1928.....	18.0	20.0	53.2	118.0	84.0	99.8	11.22	34.17	....
1929.....	16.8	18.3	131.6	117.1	79.9	103.6	10.90	30.92	....
1930.....	9.5	12.8	91.2	108.1	59.8	67.1	11.06	22.04	....
1931.....	5.7	8.2	46.0	72.6	32.0	39.0	8.69	8.97	....
1932.....	6.5	10.5	38.0	54.2	31.9	38.2	6.20	10.33	....
1933.....	10.2	13.0	82.4	69.4	52.2	74.4	8.09	12.88	....
1934.....	12.4	21.3	44.6	79.8	81.5	84.8	13.20	33.00	....
1935.....	11.1	18.4	59.3	70.3	65.5	83.2	7.52	30.54	....
1936.....	12.4	23.6	114.2	92.9	104.4	102.5	11.20	33.36	....
1937.....	8.4	20.4	52.9	78.0	51.8	96.2	8.74	19.51	....
1938.....	8.6	19.6	55.7	69.8	48.6	56.2	6.78	21.79	....
1939.....	9.1	15.4	69.7	73.4	56.8	69.1	7.94	21.17	....
1940.....	9.9	16.0	54.1	85.4	61.8	68.2	7.59	21.73	....
1941.....	17.0	26.4	80.8	92.2	75.1	94.4	9.70	47.65	....
1942.....	19.0	36.9	117.0	118.0	91.7	110.0	10.80	45.61	....
1943.....	19.9	40.5	131.0	206.0	112.0	136.0	14.80	52.10	....
1944.....	20.7	42.0	150.0	190.0	109.0	141.0	16.50	52.70	....
1945.....	22.5	36.6	143.0	204.0	127.0	150.0	15.10	51.10	....
1946.....	32.6	38.2	124.0	218.0	156.0	191.0	16.70	72.00	....
1947.....	31.9	38.0	162.0	217.0	216.0	229.0	17.60	85.90	....
1948.....	30.4	48.2	155.0	222.0	129.0	200.0	18.45	67.20	....
1949.....	28.6	45.9	128.0	214.0	124.0	188.0	16.50	43.40	....
1950.....	40.1	51.7	91.7	173.0	153.0	200.0	16.70	86.50	....
1951.....	37.9	51.1	163.0	304.0	166.0	211.0	19.50	69.30	....
1952.....	36.9	50.0	196.0	331.0	157.0	209.0	21.05	70.00	....
1953									
April.....	31.45	....	134.0	409.0	146.0	208.0	18.85	63.10	....
May.....	31.73	51.5	115.0	413.0	149.0	206.0	17.95	61.80	....
June.....	31.51	51.0	102.0	398.0	146.9	188.0	16.05	61.20	....
July.....	31.87	51.2	95.5	402.0	147.0	187.0	15.45	59.00	....
August.....	32.77	51.3	91.4	350.0	148.0	186.0	15.85	56.70	....
September...	33.09	57.6	98.9	264.0	150.0	192.0	16.15	51.50	....
October.....	32.46	52.6	89.7	233.0	134.0	194.0	16.45	52.40	....
November...	31.82	42.3	83.4	232.0	133.0	200.0	17.25	53.40	....
December....	30.73	49.2	69.9	246.0	141.0	201.0	18.25	53.00	....
1954									
January.....	30.05	48.3	69.1	253.0	142.0	203.0	19.05	52.00	....
February....	30.42	31.9	65.3	258.0	143.0	206.0	18.95	51.40	....
March.....	31.05	27.3	53.2	252.0	144.0	209.0	18.35	50.50	....
Index Numbers (Aug. 1909—July 1914 = 100)									
1928.....	145	200	76	134	131	113	95	152	147
1929.....	135	183	189	133	124	117	92	137	137
1930.....	77	128	131	123	93	76	93	98	128
1931.....	46	82	66	83	50	44	73	40	107
1932.....	52	105	55	62	50	43	52	46	100
1933.....	82	130	118	79	81	84	68	57	90
1934.....	100	213	64	91	127	96	111	146	94
1935.....	90	184	85	80	102	94	63	135	116
1936.....	100	236	164	106	163	116	94	148	108
1937.....	68	204	76	89	81	109	74	87	114
1938.....	69	196	80	79	76	64	57	97	96
1939.....	73	154	100	84	88	78	67	94	98
1940.....	80	160	78	97	96	77	64	96	122
1941.....	137	264	116	105	117	107	82	211	138
1942.....	153	369	168	134	143	124	91	202	178
1943.....	160	405	188	235	174	154	125	231	270
1944.....	167	420	214	216	170	160	139	234	236
1945.....	181	366	205	232	198	170	127	227	240
1946.....	263	382	178	248	212	209	141	319	217
1947.....	257	380	232	248	336	259	148	381	262
1948.....	245	482	222	253	201	226	155	298	253
1949.....	231	459	184	244	193	213	139	192	232
1950.....	323	517	132	197	238	226	141	384	211
1951.....	306	512	233	346	259	239	164	307	269
1952.....	298	500	281	377	245	236	177	310	274
1953									
April.....	254	...	192	466	227	235	159	280	204
May.....	256	515	165	470	232	233	151	274	182
June.....	254	510	146	453	227	213	138	271	270
July.....	257	512	137	458	229	212	130	262	216
August.....	264	513	131	399	231	210	134	251	221
September...	267	576	142	301	234	217	136	228	159
October.....	262	526	129	265	209	219	139	232	175
November...	257	423	120	264	207	226	145	237	186
December....	248	492	100	280	220	227	154	235	224
1954									
January.....	242	483	99	288	221	230	160	231	271
February....	245	319	94	294	223	233	160	228	233
March.....	250	273	76	287	224	236	155	224	246

Wholesale Prices of Phosphates and Potash **

	Superphosphate, Baltimore, per unit	Florida land pebble, 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports [2]	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports [2]	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports [2]	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports [2]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1928	.580	3.12	5.50	.669	.957	26.46	.607
1929	.609	3.18	5.50	.672	.962	26.59	.610
1930	.542	3.18	5.50	.681	.973	26.92	.618
1931	.485	3.18	5.50	.681	.973	26.92	.618
1932	.458	3.18	5.50	.681	.963	26.90	.618
1933	.434	3.11	5.50	.662	.864	25.10	.601
1934	.487	3.14	5.67	.486	.751	22.49	.483
1935	.492	3.30	5.69	.415	.684	21.44	.444
1936	.476	1.85	5.50	.464	.708	22.94	.505
1937	.510	1.85	5.50	.508	.757	24.70	.556
1938	.492	1.85	5.50	.523	.774	15.17	.572
1939	.478	1.90	5.50	.521	.751	24.52	.570
1940	.516	1.90	5.50	.517	.730	24.75	.573
1941	.547	1.94	5.64	.522	.780	25.55	.367
1942	.600	2.13	6.29	.522	.810	25.74	.205
1943	.631	2.00	5.93	.522	.786	25.35	.195
1944	.645	2.10	6.10	.522	.777	25.35	.195
1945	.650	2.20	6.23	.522	.777	25.35	.195
1946	.671	2.41	6.50	.508	.769	24.70	.190
1947	.746	3.05	6.60	.432	.706	18.93	.195
1948	.764	4.27	6.60	.397	.681	14.14	.195
1949	.770	3.88	6.22	.397	.703	14.14	.195
1950	.763	3.83	5.47	.371	.716	14.33	.195
1951	.813	3.98	5.47	.401	.780	15.25	.200
1952	.849	3.98	5.47	.401	.793	15.25	.200
1953							
April	.860	4.28	....	.430	.827	16.00	.210
May	.860	4.28	....	.430	.827	16.00	.210
June	.860	4.28	....	.361	.708	13.44	.176
July	.895	4.28	....	.396	.768	14.72	.193
August	.895	....	....	.396	.768	14.72	.193
September	.895	....	....	.396	.768	14.72	.193
October	.895	....	....	.396	.768	14.72	.193
November	.895	....	....	.396	.768	14.72	.193
December	.895	....	....	.430	.827	16.00	.210
1954							
January	.895	....	....	.430	.827	16.00	.210
February	.895	....	....	.430	.827	16.00	.210
March	.895	....	....	.430	.827	16.00	.210
Index Numbers (1910-14 = 100)							
1928	108	86	113	94	100	109	92
1929	114	88	113	94	101	110	93
1930	101	88	113	95	102	111	94
1931	90	88	113	95	102	111	94
1932	85	88	113	95	101	111	94
1933	81	86	113	93	91	104	91
1934	91	87	110	68	79	93	74
1935	92	91	117	58	72	89	68
1936	89	51	113	65	74	95	77
1937	95	51	113	71	79	102	85
1938	92	51	113	73	81	104	87
1939	89	53	113	73	79	101	87
1940	96	53	113	72	77	102	87
1941	102	54	110	73	82	106	87
1942	112	59	129	73	85	106	84
1943	117	55	121	73	82	105	83
1944	120	58	125	73	82	105	83
1945	121	61	128	73	82	105	83
1946	125	67	133	71	81	102	82
1947	139	84	135	70	74	78	83
1948	143	118	135	67	72	58	83
1949	144	108	128	67	74	58	83
1950	142	106	112	68	75	59	83
1951	152	110	112	72	82	63	83
1952	158	110	112	72	83	63	83
1953							
April	160	119	...	76	87	66	85
May	160	119	...	76	87	66	85
June	160	119	...	66	74	56	80
July	167	119	...	71	81	61	82
August	167	...	...	71	81	61	82
September	167	...	...	71	81	61	82
October	167	...	...	71	81	61	82
November	167	...	...	71	81	61	82
December	167	...	...	76	87	66	85
1954							
January	167	...	...	76	87	66	85
February	167	...	...	76	87	66	85
March	167	...	...	76	87	66	85

Wholesale Prices of Ammoniates **

	Nitrate of soda bulk per unit N	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N	High grade ground blood, 16–17% ammonia, Chicago, bulk, per unit N
1910–14	$2.68	$2.85	$3.50	$3.53	$3.37	$3.52
1928	2.67	2.30	7.06	6.63	4.92	6.00
1929	2.57	2.04	5.64	5.00	4.61	5.72
1930	2.47	1.81	4.78	4.96	3.79	4.58
1931	2.34	1.46	3.10	3.95	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.67	3.27
1935	1.47	1.15	4.59	3.10	3.06	3.65
1936	1.53	1.23	4.17	3.42	3.58	4.25
1937	1.63	1.32	4.91	4.66	4.04	4.80
1938	1.69	1.38	3.69	3.76	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.[illegible]	3.39
1941	1.69	1.41	5.50	5.32	3.76	4.43
1942	1.74	1.41	6.11	5.77	5.04	6.76
1943	1.75	1.42	6.30	5.77	4.86	6.62
1944	1.75	1.42	7.68	5.77	4.86	6.71
1945	1.75	1.42	7.81	5.77	4.86	6.71
1946	1.97	1.44	11.04	7.38	6.60	9.33
1947	2.50	1.60	12.72	10.66	12.63	10.46
1948	2.86	2.03	12.94	10.59	10.84	9.85
1949	3.15	2.29	10.11	13.18	10.73	10.62
1950	3.00	1.95	11.01	11.70	10.21	9.36
1951	3.16	1.97	13.20	10.92	10.18	10.09
1952	3.34	2.09	13.95	11.27	9.72	9.16
1953						
April	3.34	2.28	11.75	11.24	6.07	6.00
May	3.34	2.28	10.34	11.24	6.23	6.14
June	3.34	2.28	10.61	11.26	6.62	6.31
July	3.34	2.28	10.34	11.15	6.75	6.14
August	3.34	2.28	10.14	10.95	7.53	6.68
September	3.09	2.28	9.82	11.04	7.51	6.91
October	3.09	2.25	9.73	11.24	7.96	7.75
November	3.09	2.22	9.61	11.24	8.19	8.19
December	3.09	2.22	10.96	11.24	8.50	9.03
1954						
January	3.09	2.22	11.28	11.24	9.26	9.71
February	3.09	2.22	11.20	11.45	9.34	10.02
March	3.09	2.22	11.35	11.70	9.59	10.20
	Index Numbers (1910-14 = 100)					
1928	100	81	202	188	146	170
1929	96	72	161	142	137	162
1930	92	64	137	141	112	130
1931	88	51	89	112	63	70
1932	71	36	62	62	36	39
1933	59	39	84	81	97	71
1934	59	42	127	89	79	93
1935	57	40	131	88	91	104
1936	59	43	119	97	106	131
1937	61	46	140	132	120	122
1938	63	48	105	106	93	100
1939	63	47	115	125	115	111
1940	63	48	133	124	99	96
1941	63	49	157	151	112	126
1942	65	49	175	163	150	192
1943	65	50	180	163	144	189
1944	65	50	219	163	144	191
1945	65	50	223	163	144	191
1946	74	51	315	209	196	265
1947	93	56	363	302	374	297
1948	107	71	370	300	322	280
1949	117	80	289	373	318	302
1950	112	68	315	331	303	266
1951	118	69	377	310	302	287
1952	125	74	399	319	288	260
1953						
April	125	80	336	318	180	170
May	125	80	295	318	185	174
June	125	80	303	319	196	179
July	125	80	295	316	200	174
August	125	80	290	310	223	190
September	115	80	281	313	223	196
October	115	79	278	318	236	220
November	115	78	275	318	243	233
December	115	78	313	318	252	257
1954						
January	115	78	322	318	275	276
February	115	78	320	324	277	285
March	115	78	324	331	285	290

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and all Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer material‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash**
1928.....	148	152	141	121	87	177	108	97
1929.....	148	150	139	114	79	146	114	97
1930.....	125	140	126	105	72	131	101	99
1931.....	87	119	107	83	62	83	90	99
1932.....	65	102	95	71	46	48	85	99
1933.....	70	104	96	70	45	71	81	95
1934.....	90	118	109	72	47	90	91	72
1935.....	109	123	117	70	45	97	92	63
1936.....	114	123	118	73	47	107	89	69
1937.....	122	130	126	81	50	129	95	75
1938.....	97	122	115	78	52	101	92	77
1939.....	95	121	112	79	51	119	89	77
1940.....	100	122	115	80	52	114	96	77
1941.....	124	130	127	86	56	130	102	77
1942.....	159	149	144	93	57	161	112	77
1943.....	193	165	151	94	57	160	117	77
1944.....	197	174	152	96	57	174	120	76
1945.....	207	180	154	97	57	175	121	76
1946.....	236	197	177	107	62	240	125	75
1947.....	276	231	222	130	74	362	139	72
1948.....	287	250	241	134	89	314	143	70
1949.....	250	240	226	137	99	319	144	70
1950.....	258	246	232	132	89	314	142	72
1951.....	302	271	258	139	93	331	152	76
1952.....	288	273	251	144	98	333	158	76
1953								
April.....	259	264	246	139	102	256	160	80
May.....	261	264	247	137	102	245	160	80
June.....	259	260	246	135	102	253	160	70
July.....	259	261	248	138	102	252	167	75
August....	258	262	249	139	102	261	167	75
September.	256	259	249	137	97	258	167	75
October...	250	258	248	137	96	265	167	75
November.	249	259	247	137	96	267	167	75
December..	254	260	248	141	96	285	167	80
1954								
January...	259	263	250	142	96	300	167	80
February..	258	264	248	142	96	301	167	80
March....	256	264	250	143	96	307	167	80

* U. S. D. A. figures, revised January 1950. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management, Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] Beginning July 1949, baled hay prices reduced by $4.75 a ton to be comparable to loose hay prices previously quoted.

[2] All potash salts now quoted F.O.B. mines only; manure salts since June 1941, other carriers since June 1947.

**** Where range of prices for fertilizer material is quoted, average figure is used. The weighted average of prices actually paid for potash is lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period. The maximum discount is now 16%. Applied to muriate of potash, a price slightly above $.353 per unit K_2O thus more nearly approximates the annual average than do prices based on arithmetical averages of monthly quotations.**

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

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Gardens Need Fertilizer

UNLESS you have used lots of fertilizer on your garden in the past few years, it's almost sure to need some of the important plant foods.

Norman Oebker, University of Illinois Garden Specialist, says most soils need limestone as well as potassium and phosphorus.

A soil test is the best way, of course, to tell just exactly what your soil needs. The report comes back to you with specific recommendations on how much lime it takes to sweeten the soil and how much other fertilizer to use.

You can get a soil test through your farm adviser's office. Although county laboratories test for field crops, their tests are also useful for gardens, Oebker says. But you can get a more specific test for garden soil from the Department of Horticulture at the University of Illinois.

If you don't test your soil, Oebker recommends applying about 3 to 5 pounds of 5-10-10 fertilizer per 100 square feet on soils that have not been fertilized recently. Soils fertilized in the last few years would need less. Any fertilizer similar to 5-10-10 would do the job, too, Oebker says.

Nutrient Balance Affects Corn Yield . . .

(*From page* 17)

Fig. 3. Corn 93 days after planting, showing the effect of potash fertilization. (Left) 120 lbs. N, 80 lbs. P_2O_5, 80 lbs. K_2O; (right) 120 lbs. N, 80 lbs. P_2O_5, no potash. Note differences in size of stalks and ears.

lodging. In Sections B and C, nitrogen again increased lodging slightly, but grain yield was not affected.

The results obtained in this study support the belief that nutrient balance is more important to grain production than the level of any single nutrient. As mentioned above, nitrogen and phosphorus applied together gave no increase in grain production, while nitrogen and potassium or phosphorus and potassium did. Maximum yields were obtained by controlling the level of all three of the nutrients used in this test. The recommended levels from this would be 40 pounds of nitrogen and 80 pounds of both phosphoric acid and potash per acre, all applied at planting in bands below and to the side of the seed.

So You Want to Grow Alfalfa?

(*From page* 10)

Drouth Years

During the drouths of the 1930's, alfalfa was about the only legume that could survive through the seedling stage and withstand the hot summer sun. Many farmers almost gave up seeding red clover during this extended drouth due to its inability to come through the summer with a stand. More ample rainfall during the 1940 to 1950 period favored more shallow-rooted legumes such as ladino, red clover, alsike and lespedeza, with alfalfa being seeded largely by those farmers who had been successful in obtaining stands of alfalfa in the past.

Again 1953 brought drouth brown pastures, and clover seeding failures

similar to the '30's. Alfalfa became the surviving legume in many instances, for those who gave it a fair chance, and was one of the chief sources of green forages in many pastures and hay fields.

Green Thumb?

A so-called "green thumb" is not essential in obtaining a stand of alfalfa, but it might help. Some farmers may have tried to grow alfalfa before their soils were ready for this legume. Discouragement from failures led to a general opinion that alfalfa could not be grown on these low fertility areas. Of course, alfalfa does not stand wet feet, but it can be grown successfully on clay pan soils, in mixtures or alone, if the field has been conditioned by adequate surface drainage, and by proper applications of limestone and plant foods according to soil tests.

Summer Seedings

Late summer seedings of alfalfa alone are usually very successful on fertile soils. Failure of spring seeded legumes due to unusual circumstances need not break up the rotation. A good, firm seedbed and an August 1 seeding of alfalfa will bring this deep-rooted legume back into the rotation. Be sure proper fertility conditions are there before you seed.

Alfalfa "Costs" Nutrients

Each ton of alfalfa hay when growing at full speed ahead, that is, with optimum nutrient levels in the soil, will contain 30 pounds or more of potash (K_2O) equivalent, and 12 pounds or more of phosphorus pentoxide (P_2O_5) equivalent. In other words, one ton of hay may contain more nutrients than 100 lbs. 0-10-30 fertilizer. If you get three tons of alfalfa per acre from three cuttings, you have removed from the soil phosphates equal to more than 100 lbs. rock phosphate or about 180 lbs. superphosphate (0-20-0), and potash equal to that in about 150 lbs. 60% muriate of potash (0-0-60).

TABLE II.—FOUR-YEAR AND 1953 MIXED HAY YIELDS ON 16 KEY PLOTS (54 PLOTS IN SERIES), FROM THE BROWNSTOWN SOIL EXPERIMENT FIELD. TREATMENTS STARTED 1940. PLOTS ARRANGED IN ORDER OF DESCENDING YIELDS OF TREATED PLOTS.

Treatments	Hay yields, first cutting*	
	4-yr. Av., 1950-53 Tons/A.	1953 Tons/A.
0	.18	.14
LNPK	2.10	1.53
L-PK	2.00	1.99
LNP-	1.63	1.13
L-P-	1.61	.82
L--K	1.37	.69
LN-K	1.20	.69
LN--	1.14	.48
L---	1.08	.60
-NPK	.79	.53
-NP-	.67	.60
--P-	.60	.24
-N--	.53	.26
--PK	.48	.17
-N-K	.39	.23
---K	.25	.10

*(Only 1 hay crop removed; clover seed combined.)

L—Limestone, 4 tons 1940-42, 2 tons 1948-49.

N—Nitrogen, 40 lbs. topdressed on wheat, 80 lbs. sidedressed on corn.

P—Phosphates, 200 lbs. 0-20-0 drilled with wheat, and 200 lbs. 0-20-0 broadcast ahead of corn.

K—Potash, 50 lbs. K_2O per acre per year average, broadcast ahead of corn, wheat and clover.

Summary

The experimental data and photos shown here help in answering the question—"How can I improve my legume stands, particularly alfalfa?"

Where alfalfa is included in the mixture, growers may capitalize year after year, not only on the high-protein hay, but also on the deep-rooting qualities of this legume.

Those who have not tried alfalfa should start by including some alfalfa in the regular legume seeding mixture.

TABLE III.—HAY YIELDS AND PERCENTAGES OF VARIOUS SPECIES FOUND BY SEPARATION STUDIES AT NEWTON AND TOLEDO SOIL EXPERIMENT FIELDS, 1953.

Field and Treatment	Total yields of mixed hay			Percentages of different species in mixed hay				
	4 yr. Av. Tons	1953 Tons	1953 Est.* Tons	Alfalfa	Red Clover	Alsike	Timothy	Weeds, etc.
Newton								
R---.....	.17	0	.33	0	0	0	15	85
RL-K.....	1.10	1.14	1.33	23	51	19	6	1
RLP-.....	1.96	1.13	1.31	12	13	11	58	6
RLPK.....	2.45	2.11	2.55	46	41	4	7	2
Toledo								
R---.....	.44	.09	.58	2	4	9	55	30
RL-K.....	1.26	.75	1.15	2	66	13	17	2
RLP-.....	1.30	.71	1.18	7	13	2	61	17
RLPK.....	2.03	2.06	2.25	38	39	10	11	2

* These hay-yield estimates by the small sample technic are higher than actual yields obtained by mowing and raking, as might be expected. Hand sampling cuts plants lower to ground, all material was picked up, and there was no loss of leaves. Small sample estimates used for yields shown in graph, Fig. 3.

This is especially advisable where limestone has been applied for the first time only recently.

But if you really want to grow alfalfa for hay or pasture, apply the "full treatment" as indicated by soil tests, and you have a good chance of having a supply of the best protein feed, even in dry seasons. But do not kid yourself. One cannot starve alfalfa and expect it to survive and produce high yields.

The Fertilization and Liming . . .

(*From page* 14)

should be from the standpoint of satisfying the annual needs of the crop for available nutrients. That these fertilizer recommendations have been and are now being followed in many orchards and vineyards would indicate that the minimum needs of the fruit plants for a good crop have been satisfied.

In following these recommendations more nitrogen and phosphorus are being added to the soil each year than may be taken up by the plant. If leaching and volatilization losses of nitrogen are counterbalanced by additions from rainfall and non-symbiotic nitrogen fixation, then it would appear that removal by cropping and erosion would have to be counterbalanced with symbiotic nitrogen fixation by adapted legumes and by fertilization. When ladino clover is grown, it can or should be able to take care of its own nitrogen needs by symbiotic fixation, and also provide some for the tree. That this often happens is evidenced by the superior growth and vigor of apple trees in ladino clover sod. The nitrogen fertilization program for apples in grass sod must of necessity provide for heavier annual additions. Ring or band application of nitrogen for the tree

usually assures the greatest efficiency in uptake per pound applied regardless of the type of sod grown.

Losses of soil and fertilizer phosphorus by erosion and runoff may be greater than commonly supposed, especially in those orchards and vineyards where little attention is given to sound soil and water conservation practices. There are very few instances where the available supply of soil phosphorus has limited growth and yield, at existing standards of what is presently considered a good economic level of fruit production per acre.

The present potassium situation in orchard and vineyard soils is representative of a period of change. The amounts of potash contained in a good crop of apples, peaches, and grapes provide a clue as to which fruit plant might first evidence a need for a supplemental supply of available potassium. Peach trees, growing under certain conditions of adverse soil moisture relations, high potassium fixation capacity of the soil, or low total supply of soil potassium, have shown a marked response to potassium fertilization. The same is true for apples and grapes. Practices such as manuring or mulching, with straw or hay, which improve soil moisture conditions or add high potash materials to the soil often correct or alleviate deficiency effects. Large additions of potash to acid, sandy soils often induce a magnesium deficiency.

Most fruit trees and grapevines seem to be able to tolerate very acid soil conditions, which still exist in many orchards and vineyards. Acidity is usually greatest beneath the trees or vines. This is due to the large amounts of sulfur previously used in spray mate-

TABLE I.—APPROXIMATE BALANCE SHEET OF N, P_2O_5, K_2O REMOVAL AND ADDITIONS FOR APPLES, PEACHES, AND GRAPES

	Pounds per acre		
	N	P_2O_5	K_2O
Apples—400 bu. per acre—Require* (30 trees per acre)	30	10	35
Fertilizer Recommendation			
Tree: .04-.05 lb. N per year of age of tree to 30 years	45		
Sod—ladino clover. 300 lbs./A 0-20-20		60	60
Approx. nitrogen fixation	100		
Bluegrass: 300 lbs./A 10-10-10	30	30	30
Peaches—350 bu. per acre—Require (70 trees per acre)	60	18	70
Fertilizer Recommendation			
Tree: .08 lb. N per year of age of tree in spring to 10 years	56		
Cover Crop: 400 lbs./A 5-10-10 at seeding	20	40	40
For both: 600 lbs./A 10-10-10 in spring	60	60	60
Grapes—4 tons per acre—Require (600 vines per acre)	25	10	35
Fertilizer Recommendation			
Vines: 50 lbs. N per acre in spring	50		
Cover Crop: 400 lbs./A 5-10-10 at seeding	20	40	40

* Approximate requirements of these crops for N, P_2O_5, and K_2O were obtained from "When Fertilizing Consider Plant Food Content of Crops" by J. D. Romaine, Better Crops With Plant Food.

rials which ultimately reached the soil, and to the fact that very little if any liming was ever done beneath trees or vines. In many limed orchard and vineyard soils, the pH of the surface soil in the middles may be 6.0 to 7.0, whereas beneath the tree or vine it can be found as low as 3.5 to 4.0. Applications of sufficient amounts of lime to raise the pH of very acid soils to 6.5 to 7.0 have often induced marked nutritional disorders in the growing tree or vine. Liming of orchard and vineyard soils is recommended primarily for the benefit of the sod or cover crop. Use of dolomitic limestone may help to correct incipient or prevent the occurrence of magnesium deficiency. Where lime is needed to correct a very acid soil condition it should be applied in safe increments, to allow for a gradual adjustment in the chemical and biological status in the limed layer of soil.

Present fertilizer recommendations for apples, peaches, and grapes are a definite improvement over the old nitrogen-only program. In many instances the rates of application of nitrogen and/or potassium may be too low to meet the nutrient requirements of the tree or vine for maximum economic production. It should be recognized that as the uptake of certain elements is facilitated by increasing their available supply to the plant, deficiencies of other elements may be induced or greatly accentuated.

The most important characteristic of these fertilization and liming recommendations for Pennsylvania conditions is the emphasis placed upon the use of judicious quantities of fertilizer for the direct benefit of the sod or cover crop. Proper management of this crop is the only practical means by which real improvement in the physical, biological, and fertility status of most fruit soils can be achieved.

Some Reasons for Poor Crop Stands

(*From page* 26)

the extent of internal damage which may not become evident until after planting and then, perhaps, not in an understandable way. The standard official seed laboratory test taken immediately after processing does not fully detect the full amount of internal injury. These valuable laboratory tests are correctly conducted under so-called optimum and reproducible condition, a condition seldom if ever encountered in planting. Furthermore, the elapse of time, with its importance to temperature and moisture effects, between the germination test and planting, permits critical degeneration processes to continue to weaken the vigor and vitality of the seed. This continued degeneration of seed after testing has not received the attention deserved. Seed can still be legally sold if tested 9-10 months prior to sale.

Hard, life-weakening knocks continue as a seed bounces itself and other seeds, and in turn is bounced haphazardly about by seeds from one place to another. It is bounced from the cylinder to a container, later into storage and then through various types of processing equipment. It is similarly bounced back into storage and later through all phases of the commercial seed channels and then onto farms and into planter boxes and ultimately into the seedbed. All of these contacts are not without effect upon crop stands.

Moisture and Temperature Effects in Storage

Storage conditions furnish a fourth important explanation for poor crop stands. It is here that moisture and temperature, with time on their hands, play their important natural and exacting roles in deteriorating seed vigor and

vitality. Again it should be emphasized that seed previously weakened cannot withstand storage conditions as well or as long as can perfectly sound seed. High temperature and moisture in storage gradually weaken and degenerate all crop seeds and may work rapidly on weakened seeds.

Low moisture and temperature levels remarkably preserve valuable seed vigor and vitality by slowing down degeneration processes and by making conditions less favorable for destructive microscopic life. As either or both moisture and temperature, when starting at low levels, become progressively higher, however, aging processes become substantially greater until critical temperatures first weaken and later kill plant structures.

Emphasis should be given to the close relationship between moisture content of seed in storage and the relative humidity of the air surrounding the seed. Dry seed, for example, will gradually absorb water from a moist atmosphere. Likewise, should the seed originally contain a high percentage of moisture and the atmosphere a low percentage, the air will gradually remove moisture from the seed until a definite balance of forces has been reached. A knowledge of this relationship is important in maintaining proper storage conditions. Research has shown that if the moisture content of the seeds in storage is sufficiently low when in balance with the moisture content of the air so as to keep the relative humidity below about 70%, seed respiration does not become excessive for practical periods of storage. Microorganisms, below this level of humidity, cannot rapidly deteriorate seed structures. Respiration has been shown to increase gradually with increasing seed moisture up to a level permitting about 70% relative humidity, then the increases become rapid with further increases of seed moisture. Hybrid corn growers have heard that approximately 13-14% moisture in corn is a safe content for storage. Small grain is about the same. Oil crops, however, differ considerably from the non-oil crop seeds in this regard. Since the oil does not absorb water and also constitutes a high percentage of weight, oil seeds as cotton seed, soybeans, and peanuts must have a moisture content of about 9-11% to remain at or slightly below this safe maximum moisture level.

Further interesting studies have also been made showing the way that life and vigor in seed could be altered by adjusting the moisture content of the seed and the temperature of storage. Dr. Toole (5) of Beltsville used soybeans in one of the studies. Seed with a moisture content of 13½% when stored at 86°F. were unable to retain life for more than 5 months. Similar seed when stored at 68°F. retained life for about two years. When a storage temperature of 50°F. was used, full viability was retained for 3 years, but life vanished rapidly after this period. At the same time, where the seed moisture had been reduced to 8-9% and the seed then stored at 50°F., life with evidence of being at its fullest still existed at the end of a 10-year period.

Cotton storage studies by Simpson (3) are equally interesting and suggestive. Cotton seed with 14% moisture when stored at air temperature had been overcome by death processes within 12 months. Seed containing 13% moisture were all dead in about 24 months; whereas, at 11% moisture, a 36-month storage resulted in complete death. Seed with 9% moisture, on the other hand, literally resisted visible evidence of the ever-present death processes and germinated as well at the 36-month period as it did when first stored.

Similar trends, resulting from variations in moisture and temperature levels in storage, are evident for many kinds of garden and field crop seeds. The effects of given levels of moisture and temperature, however, differ for different kinds and lots of seeds.

Evidence continues to accumulate to emphasize that on one hand we have seed with life at its fullest; whereas on the other hand, death processes have taken over. Since normal life does not change abruptly unto death, there are present between these extremes many degraded levels of vigor. Seed with increasing time is gradually but constantly being changed in one direction only—that of lessened vigor and ultimate death. The time required for a complete change may be short, or it may be long, depending upon the mechanical and physical condition of the seed going into storage and the favorableness of storage conditions. It is significant to note that seed, as soybeans, may be inwardly young at more than 10 years of age or old at the age of a few days or weeks, thus suggesting that the invisible forces determine age—not the days after harvest.

Other Important Factors

After the seed are planted, life may frequently hang in balance where good seed tend to tilt the balance toward continued survival, and weakened seed towards death.

As an additional factor influencing crop stands, soil temperature may be considered a powerful force working for or against survival of plants, depending upon its level. It establishes for each seed a rigid limitation as to whether germination and growth are possible and, if so, to what degree. Temperature at low level slows down water movement into the seed and through it. It also restricts absorption and especially the utilization of essential plant-food elements, regardless of how plentiful they are. It permits the accumulation of advantages for seed decaying and damping-off organisms so that they are greatly favored to do their damage. By delaying seedling development, if not by preventing it, low temperature is responsible for other natural adverse forces, such as soil compacting and crusting, diseases, insects, birds, and weeds gaining detrimental advantages in the balance of power. It has also been noted that many seedlings that have been delayed in emergence by low temperature are conditioned for a period of sluggish growth.

Different levels of soil temperatures influence plants differently. As the soil temperature increases above the minimum level for germination and growth, a range of temperatures in which plant growth can continue without detrimental influence of the temperature is encountered. At still higher temperatures, germination and growth may proceed satisfactorily for only a short time before the high temperature levels result in a "fatigue" and the seedling no longer continues normal growth, unless a lower temperature is alternated with the higher. With still increasing temperatures, the fatigue occurs sooner and critically damages or kills the seedling. Many seedling abnormalities occur at these critical temperatures, which for common summer grown crops are to be found above approximately 90° to 105°F. The degenerating processes quickly brought about by the "fatiguing" levels of temperature are thought to be somewhat similar to those occurring in storage but with longer periods of time.

High temperatures during germination and emergence may appreciably affect the growth habit of seedling in other respects also. Stunting has been mentioned. Oftentimes stunting of plant growth is associated with a seedling root that fails to grow. It has been suggested that this condition may also in turn be due to injury to the upper growing region of the plant. Less severe but important changes may be illustrated by observation of wheat and sorghum seedlings.

Wheat seedlings when developed at a temperature of 46°F. have been shown to have secondary roots developed at the planting depth of the seed; at 75°F., on the other hand, these roots develop at or near the soil line

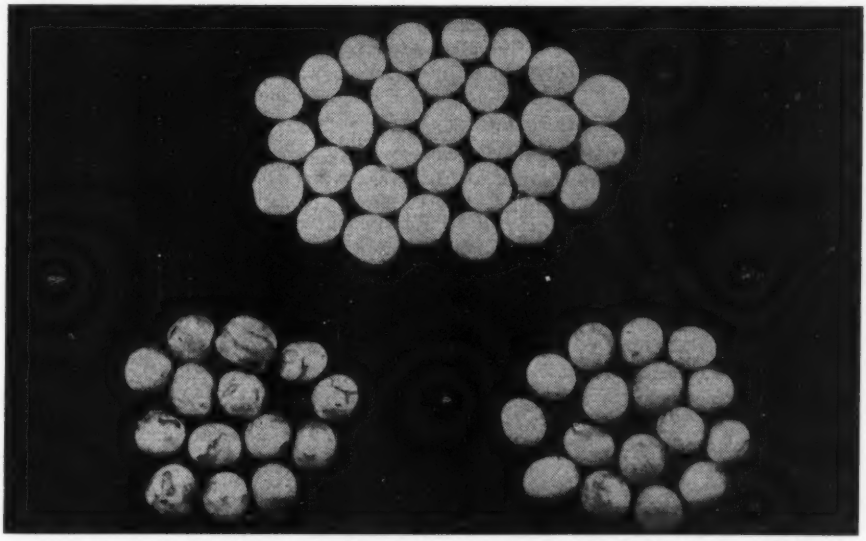

Fig. 3. A single lot of soybeans seeds showing the effects of rough handling in harvest. The upper group represents the processed lot of seeds as placed on the market. The lower two groups are similar to the above except that they have been stained and divided to emphasize the extent of seed-coat damage as shown by the group on the left. The group on the right did not show obvious damage. The laboratory germination showed 92% viable seed. Field emergence, however, would likely be inferior, especially under adverse conditions.

regardless of depth of seeding. It has also been observed by Dickson (1) that at 68°F. the young seedling leaves always broke through the coleoptile (cylindrical structure that normally emerges first) before the tip of the coleoptile reached the soil surface. At temperatures below 61°F., however, the coleoptile elongated much faster than the seedling leaves and consequently enclosed the leaves until after emergence. The latter condition is normal and promotes better crop stands.

In case of sorghum seedlings, Martin (2) has found that at temperatures of 77°F., many crowns (base for the stalk) formed above the soil surface, whereas at lower temperatures, the crowns remained below ground.

Many other important reasons for poor stands of crops that could be discussed if time permitted include:

1. Failure to plant to stand.
2. Improper selection of planter plates.
3. Excessive speed of planting equipment.
4. Planting in loose seedbeds.
5. Seeding too deep or too shallow.
6. Failure to treat seed effectively with fungicide.
7. Failure to inoculate effectively.
8. Failure to rotate crops adequately to keep insects and disease population at a minimum.
9. Late seeding.
10. Improper fertilization and liming.
11. Planting in or above bands of fertilizer.
12. Insects and other pests.
13. Diseases.
14. Drought.
15. Excess soil moisture.

If we are to improve crops stands, we must become conscious of their importance and of the many adverse factors affecting stands and then exercise proper precautions in avoiding the factors or in minimizing their detrimental influence. We must make ourselves realize that many of the factors mentioned, plus others, act both independently and together, each taking

a toll of plants. Sometimes, the effects of each factor are small and not noticeable, but the total effects of many or all factors in the end become of major importance. Regardless of the causes, poor stands and the often associated weak growth of surviving plants are one of agriculture's worst enemies.

The large profitable benefits of a good stand oftentimes may be had at no additional cost. Poor stands are costly stands, so let us join forces to uncover and bring under control as many of the causes as possible. Good stands will increase the efficiency of fertilizer, labor, and all other factors of efficient crop production.

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Tung Culture Finds A Place . . .

(*From page* 24)

it has developed in an area without crowding any other crop. The income derived from the tung industry has been additional income for the counties in which tung is grown extensively. This has greatly influenced the total farm income in some counties.

The production of tung nuts and the estimated value for the State of Mississippi are given in Table IV. In 1952 and 1953 the tung nut crop was valued at more than $5,000,000. More than half of this volume was produced in one county. This was Pearl River,

Fig. 11. Crimson clover provides some grazing during the winter and early spring months. This makes it possible for the grower to obtain another income from the tung orchard land. (Courtesy of W. W. Kilby)

TABLE I.—APPROXIMATE AVERAGE REQUIREMENTS OF THE ESSENTIAL ELEMENTS NITROGEN, PHOSPHORUS, AND POTASSIUM PER TUNG TREE AND PER ACRE

ALABAMA, FLORIDA, AND GEORGIA [1]

Age of tree (years)	Formula [2]	Amount of fertilizer required in—					
		70-tree planting		100-tree planting		140-tree planting	
		Per tree	Per acre	Per tree	Per acre	Per tree	Per acre
	Ratio	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Newly planted.	6– 6– 6	1	70	1	100	1	140
1.....	6– 6– 6	2	140	2	200	2	280
2.....	10– 5–10	3	210	3	300	3	420
3.....	10– 5–10	4	280	4	400	4	560
4.....	10– 5–10	6	420	5	500	5	700
5.....	10– 5–12	8	560	6	600	6	840
6.....	10– 5–12	12	840	8	800	7½	1,050
7.....	10– 5–12	14	980	10	1,000	9	[3] 1,260
8.....	10– 5–12	16	1,120	12½	[3] 1,250	9	1,260
9.....	10– 5–12	18	[3] 1,260	12½	1,250	9	1,260

LOUISIANA, MISSISSIPPI, AND TEXAS

Newly planted.	5–10– 5	1	70	1	100	1	140
1.....	8– 8– 4	1½	105	1½	150	1½	210
2.....	8– 8– 4	2	140	2	200	2	280
3.....	12– 6– 9	3	210	3	300	3	420
4.....	12– 6– 9	4	280	4	400	4	560
5.....	12– 6– 9	6	420	5	500	5	700
6.....	12– 6– 9	8	560	7	700	6½	910
7.....	10– 5–10	11	770	9½	950	7½	[4] 1,050
8.....	10– 5–10	13	910	10½	[4] 1,050	7½	1,050
9.....	10– 5–10	15	[4] 1,050	10½	1,050	7½	1,050

[1] Additional requirements for this area: On light soils, magnesium (calculated as magnesium oxide (MgO)) and applied at half the rate for potash. For young trees, 2 to 4 ounces of zinc sulfate per tree annually for the first 3 or 4 years.

[2] Ratios stated in pounds (per cent) of nitrogen, phosphoric acid (calculated as phosphoric pentoxide (P_2O_5)), and potash (calculated as potassium oxide (K_2O)), contained in 100 pounds of mixed fertilizer. Difference between ratio totals and 100 made up by additional fertilizer elements or filler. Formulas, amounts, and fertilizer sources may be varied so long as equivalent amounts of the basic nutrients are supplied.

[3] The amount per tree remains constant for this area after a maximum of 1,250 to 1,260 pounds per acre is attained.

[4] The amount per tree remains constant for this area after a maximum of 1,050 pounds per acre is attained.

NOTE: This Table was taken from Farmer's Bulletin No. 2031, U. S. D. A. by Dr. Potter and Dr. Crane.

the county in which the Tung Experiment Station is located. This leads our attention to how much more the farm income of that county is now than it was before tung production became important.

In addition to the income from tung nuts, the well-drained soils on which the orchards are usually established produce winter cover crops that can be grazed by cattle or sheep. By following this practice the farmers are able to get another income from the same land by way of beef, milk, or mutton and wool.

Along with the total income from a good crop of tung nuts, one must also consider the cost of producing this crop. In 1949, it was estimated that the fertilizer, cultivation, hoeing, etc.

TABLE II.—EFFECT OF NITROGEN AND POTASSIUM ON PERCENTAGE OF POTASSIUM IN LEAVES, AND ON OIL CONTENT AND VALUE OF TUNG FRUIT.[1]

Year	Nitrogen and phosphorus applied			Nitrogen, phosphorus, and potassium applied		
	K in leaves	Oil content	Price per ton [2]	K in leaves	Oil content	Price per ton [2]
	per cent	*per cent*	*dollars*	*per cent*	*per cent*	*dollars*
1943	.85	21.0	$76.50	.96	21.2	$77.40
1944	.70	20.3	73.35	.95	21.0	76.50
1945	.62	18.9	68.04	.89	20.3	73.35
1946	.56	18.4	66.24	.76	20.7	75.15
1947	.42	19.0	67.50	.78	19.9	71.55

[1] An adequate level of phosphorus was applied to all plots. Trees were 6 years old in 1943.
[2] $72.00 per ton, less $3.60 for each unit of oil under 20.0, or plus $4.50 for each unit above 20.0 (1947 price scale).
Taken from Mississippi Experiment Station Bulletin #464, 1949.

cost $30-$35 per acre. The cost of harvesting and marketing for the same season varied from $10 to $25 per ton of nuts produced (5). These figures indicate the necessity of proper land selection and good management in order to produce high yields per acre. An orchard that never produced more than one ton of nuts per acre would probably never be very profitable. As mentioned before, some well-managed orchards which were planted on suitable soils are now producing 2 to 3 tons of nuts per acre. Larger yields may be expected in the future when more research information on varieties, fertilization, and cultural practices is available.

As mentioned before, tung production is a long-time enterprise. The trees begin to bear about the third year and about six years are required for a tree to reach the stage of commercial production. The life of the tree is governed by the soil on which it is planted. On good land a tung orchard might be expected to produce for 30 years or more.

The success of tung production in the lower portion of the Coastal Plain is a part of the over-all "wise land use" movement and an example of another opportunity in the agriculture of the

TABLE III. TUNG NUT PRODUCTION IN TUNG BELT *

	Average 1942–51	1952	1953
	Tons	*Tons*	*Tons*
Georgia	819	300	300
Florida	9,900	31,000	32,000
Alabama	946	2,800	2,600
Mississippi	20,686	67,800	85,000
Louisiana and Texas	10,446	30,200	25,000
United States	42,797	132,000	144,900

* Source: Crop Reporting Board, U.S.D.A.

TABLE IV. TUNG NUT PRODUCTION IN MISSISSIPI *

Year	Tons	Value of Production
1942–51 Average	20,686	.....
1949	43,600	$2,525,000
1950	20,800	1,546,000
1951	32,900	3,200,000
1952	67,800	5,356,000
1953	85,000	5,950,000

* Source: Crop Reporting Board, U.S.D.A.

South. Our agriculture progresses along with our knowledge of the soils. With an understanding of them, agricultural people are in position to make sound general and specific recommendations that will promote high production per unit of land.

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High and Mighty

(*From page* 5)

better than the countywide approach, it strikes me that this is apt to throw a bigger focus on the present value of the vo-ag teacher and his clients.

However, this is no time to rig things so there is bothersome competition or jealousy between these two agencies that are earnestly trying to get out beyond the fringe of farmers whose ability and desire to learn have kept them in the forefront of beneficiaries. The idea seems to be to keep on serving these alert and progressive fellows, but to try to influence more of the chaps who have hitherto been indifferent to extension. (It should be pointed out that not all farmers seemingly untouched by college influences are backward or financially weak.)

Educators tell me that at no time have vo-ag departments been more perplexed about ways and means to shoulder the additional duties which naturally follow any extra work outside of school hours. This work deals mostly with young farmers not in school and adult farmers—both those who have been students and others who never have enrolled.

Take the young farmers. Plenty of them are ready and anxious to find help. Their investments are high or meager —either way; and they need so much equipment and facilities to keep step these days that some practical advice is welcome. Their mental attitude toward education in general is better than former generations had. They look to their community for aid because they expect to stay in that community and render the best returns they can—after they are firm on their feet.

Here is a problem to be met and it's not always met head-on. I am told that sometimes the local high school boards and supervisors think they have little responsibility for servicing these kids who are not in high school. Moreover, the existing regulations as to division of time by the teacher usually emphasizes regular high school enrollment.

Others claim that FFA programs among the enrolled students tend to further subtract time from all that's available in decency to a hard-pressed instructor. It wouldn't do to break in on these worthy activities too much. Yet out there in the community live scores of fine lads who must be deprived of teacher contacts in the meantime.

It has often seemed to me that the FFA chapters might do a great piece of helpful community service by making some kind of a useful contact with their comrades who have been denied these benefits. This isn't "slumming" or "missionary work." It's being willing to invite some of the absentee youth into their charmed circles.

In some places teachers have managed to hold vocational classes three days weekly instead of five days. Such a division of time could well be used for

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reaching many of the non-enrolled youth. In other cases rather small classes have been combined to save time. Here and there an extra teacher has been hired, but often this happens only when the regular high school enrollment rises fast.

Like the county agent, the vo-ag teacher is entitled to a little time for himself and his family. Sometimes neither of them get it owing to the pressure and the detail. Hence as it is, no reasonable school directorate ought to expect the teacher to reach the farm-bound youths entirely on his own free time after hours.

Reliable figures show that there are roughly 750,000 persons enrolled in vocational agriculture. Of these about 272,000 represent the adult farmers. Regular all-day class members number about 425,000.

IN a survey made in Illinois among adult farmers who had finished considerable high school classwork, a large majority declared they had secured most benefit through new ideas by hearing other farmers discuss their methods during informal class assemblies. No doubt the same is true where regular extension meetings are held.

Another group said that the teachers contributed much by making visits to the farms. It seems that they helped in solving current problems as well as in giving direct instruction in certain special practices. At this point we hear reports from another state where the vo-ag teachers seem rather shy about trying to go out and tell adult farmers what to do and when to do it. Other teachers believe they are short of time to handle adult classes. Some of them are spending 56 hours a week on day students and out-of-school groups. Both lack of time and lack of self-confidence retard the adult farmer services.

So each community has to do the best it can working under varying rules and different shades of opinion and experience. No set formulas can be worked

out easily. Moreover, there's a limit to both time and available money with which to do the "reaching out" act.

IN summary, there's more to teaching than equipment and funds. They help a lot. So do a sympathetic, enthusiastic school board and a farm-minded principal. But good as they are, they can't equal the value of a "natural-born" and zealous teacher. You can pile up figures and read surveys until black in the face and weary, but you never get beyond that important point of teacher-training and individual competence and inspiration.

There's no use pushing and herding a mixed lot of graduates from ag colleges into vo-ag teaching either. That only dilutes the quality. Some men are made for teaching and never go sour on it. Others think they are pretty smart cookies and able to handle any bunch of freshmen who ever enrolled. After awhile when things get thick and human problems crowd into the picture, these wise guys poop out. It's much the same in the county agent business, too. Only the best ones survive and gain the confidence of their community.

It's amazing in a way, how these tiptopmost successes in pedagogy accomplish things without fanfare and hullabaloo. Sometimes maybe they don't blow their horns hard enough, yet a lot of tooting never disguises poor teaching in the long run.

Finally, how fast and far do we care to go anyhow in an all-inclusive extension program through the high schools? Plenty of excellent work is being done already. I think it's a safe rule to follow the actual desires of the community in that regard. True, you can stimulate it by sound teaching and youth leadership.

It's better to be happy about what we have accomplished and gear ourselves to our capacities than it is to extend ourselves away out on a limb that may break and give us a tough tumble.

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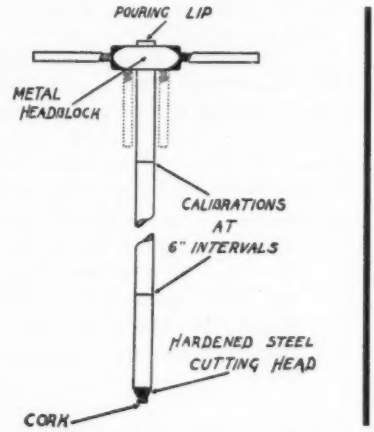

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THE AMERICAN POTASH INSTITUTE

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A hillbilly came to town carrying a jug of liquor in one hand and a shotgun in the other. He stopped a man on the street, saying—"Here, friend, take a drink outa my jug."

The man protested he didn't drink.

The hillbilly leveled his shotgun at the stranger and said—"Drink."

The stranger drank, then he shuddered, shook, shivered and coughed. "Gad, that's awful stuff."

"Ain't it?" said the hillbilly. 'Now hold the gun on me until I take a gulp."

* * *

A young officer who was highly efficient was inspecting Selective Service Headquarters in a Southern city. Noting that the number of desks, telephones, and typewriters seemed far in excess of personnel, he asked one of the girls, "What is the normal complement of this office?"

The girl was puzzled only for a moment, "Well, suh," she replied, "Ah believe the most usual compliment is 'Howdy, honey, you're sure luscious-lookin' this mawnin'."

* * *

The minister came to dinner with his collar unbuttoned. "I have a very painful boil on my neck," he apologized, "but then, we must endure such misfortunes with patience. Suffering is inflicted on us at times to try us."

The little six-year-old listened and then inquired: "Well, if you're supposed to suffer, why don't you button up your collar?"

Woman, trying on fur coat, to the salesgirl: "I wish it were called something besides broadtail. My husband fancies himself a comedian."

* * *

An old maid spending her declining years raising chickens was having trouble with them. She called the county agricultural agent who visited her farm, looked at her flock, and said:

Farm Agent—"Madam your hens have coccidiosis."

Maiden Lady—"That's impossible. There hasn't been a rooster with them for six months."

* * *

A farmer, tired of being single, went to town, chose a wife, married her, put her on the back of his horse and started home.

Suddenly the horse stumbled. "That's once," said the farmer, and went on his way. The horse stumbled again. "That's twice," said the farmer. The third time the horse stumbled the farmer said, "That's three times." He and his bride dismounted, and he took his rifle and shot the animal.

"Whatever possessed you to do that?" the bride asked; and she thereupon began a long-winded tirade about the farmer's stupidity. He listened for several minutes, looked steadily at his wife, and remarked quietly: "That's once."

* * *

One feminine mystery that puzzles the average husband is why they call it a "permanent" wave.

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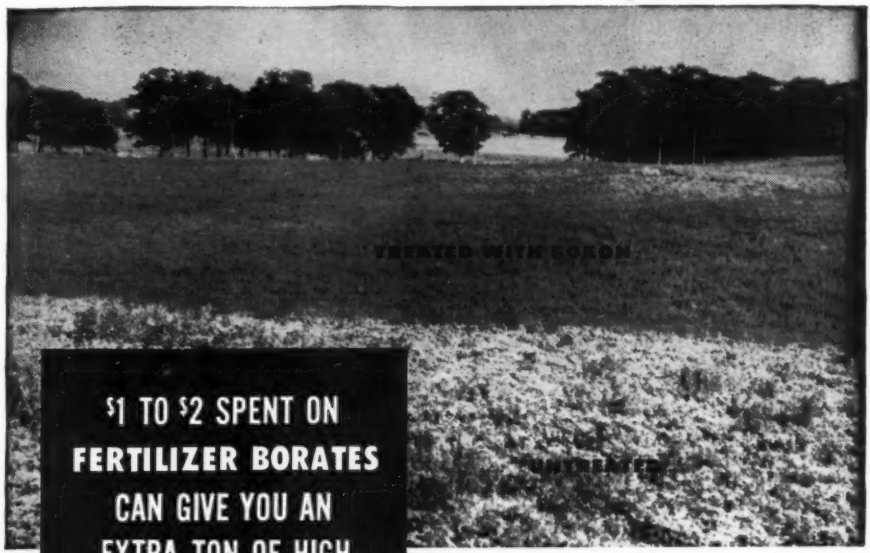

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